TRANSIT FIELD BOOK

No. 8152-00

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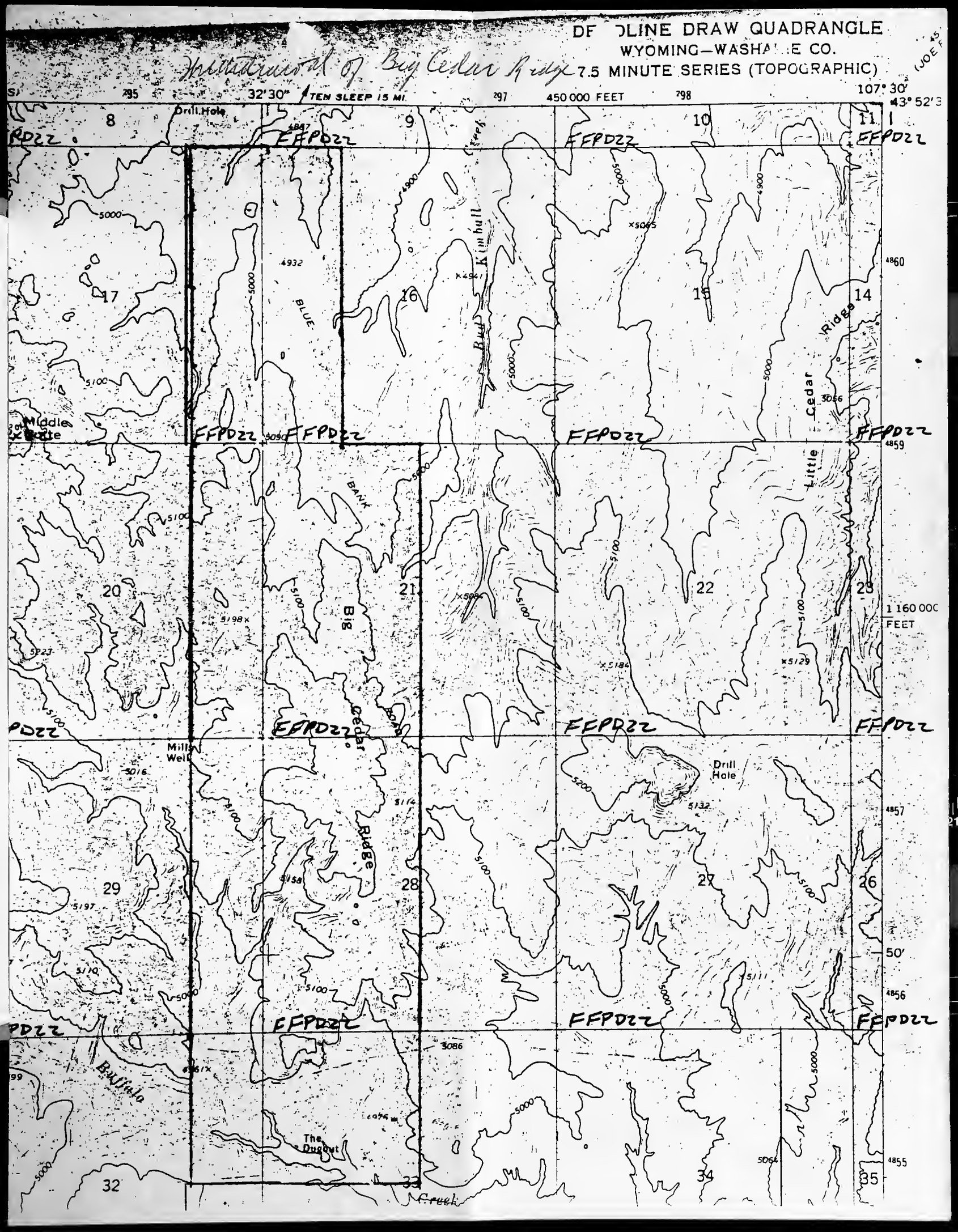
This Book is manufactured of a High Grade 50% Rag Ledger Paper having a Water Resistant Surface, and is sewed with Nylon Waterproof Thread.

INDEX


DF OLINE DRAW QUADRANGLE
WYOMING—WASHA E CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
Initial Record of Big Cedar Ridge
32°30"
TEN SLEEP 15 MI.
450 000 FEET
107° 30'
43° 52'
Drill Hole
Middle
Kimball
Big
Cedar
Ridge
Little
Cedar
Ridge
BLUE
BANK
Big
Cedar
Ridge
Mills
Well
Drill
Hole
Buffalo
The
Dugout
Creek
1 160 000
FEET
50'

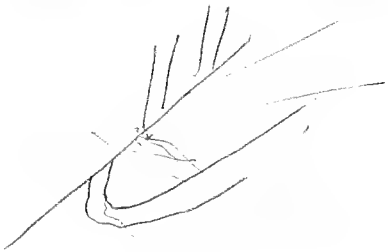
GENERALIZED STRATIGRAPHIC COLUMN NEAR RED LODGE, MONTANA

		REGIONAL THICKNESS	
EOCENE	ABSAROKA VOLCANIC SUPERGROUP	6000'	MAINLY ANDESITIC, BASALTIC, AND DACITIC VOLCANICLASTICS (INCLUDING BRECCIAS, CONGLOMERATES, SANDSTONES, SILTSTONES, AND TUFFS) INTERBEDDED WITH LAVA FLOWS AND VENT BRECCIAS; PETRIFIED TREES AND LEAF FOSSILS COMMON.
	WILLWOOD FM	2300'	VARIEGATED UNITS OF GRAY, RED AND PURPLE MUDSTONES WITH OCCASSIONAL THIN SANDSTONES. MAMMALIAN BONES COMMON, PLANT REMAINS PRESENT IN TABULAR AND LENTICULAR CARBONACEOUS SHALES.
PALEOCENE	FORT UNION FM	3,000'-12,000	INTERBEDDED YELLOWISH, LENTICULAR SANDSTONES AND YELLOW-GRAY MUDSTONES; LACUSTRINE BELFRY MEMBER NEAR MIDDLE; COAL-BEARING MEMBER IN UPPER PART; SYNTECTONIC CONGLOMERATES AND BRECCIAS AT TOP OF SECTION ALONG MOUNTAIN FRONT; FOSSIL LEAVES COMMON, BONES RARE.
CRETACEOUS	LANCE FM	750-1000'	THICK AND LATERALLY EXTENSIVE YELLOW SANDSTONES INTERBEDDED WITH DRAB, GRAY MUDSTONES; OCCASSIONAL DINOSAUR BONES.
	MEETEETSE FM	1200'	BANDED GRAY MUDSTONES WITH INTERBEDDED SANDSTONES AND OCCASIONAL THIN LIGNITES. MUDSTONES ARE ROOTED AND CONTAIN PLANTS, FRESHWATER MOLLUSCS, AND DINOSAUR BONES; A SANDSTONE UNIT NEAR MIDDLE CONTAINS A MARINE TRACE FOSSIL ASSEMBLAGE.
	JUDITH RIVER FM	500-900'	LIGHT-COLORED YELLOWISH SANDSTONES INTERBEDDED WITH YELLOWISH-GRAY SANDY SHALES AND SILTSTONES; FEW BEDS OF DARK GRAY CARBONACEOUS SHALES; OCCASIONAL THIN COAL BEDS; COMMON DINOSAUR BONES AND OCCASSIONAL FOSSIL PLANTS
	CLAGGETT FM	120-500'	BROWN TO GRAY SHALE WITH STRINGER SANDS NEAR TOP, GRADING UPWARD INTO MASSIVE RUSTY SANDSTONE, COMMONLY DARK NEAR BOTTOM AND LIGHTER NEAR TOP - PARKMAN MEMBER; THICK BENTONITE BELOW SHALE, NEAR BASE OF FORMATION.
	EAGLE FM	200-550'	INTERBEDDED RIDGE-FORMING SANDSTONES WITH INTERBEDDED SHALES; COAL BETWEEN LOWER SANDS; SANDSTONES NOT CONTINUOUS; MASSIVE, RUSTY, PITTED SANDSTONE AT BASE - VIRGELLE MEMBER.
	TELEGRAPH CREEK FM	150-400'	GREENISH-GRAY SHALE, SOME GYPSUM; SALT AND PEPPER SANDSTONE FORMS SHOULDER-LIKE MOUND IN UPPER PART; TWO PROMINENT RUSTY SANDSTONE RIDGE-FORMERS AT BASE, VERY FOSSILIFEROUS - ELK BASIN SANDSTONE MEMBER.
	CARLILE - NIOBRARA SH / CODY SH	1000-1600'	VERY THICK SHALE, GRAY ON FRESH SURFACE, WEATHERS ALMOST WHITE; VERY LARGE CONCRETIONS NEAR TOP AS WELL AS LOWER IN FORMATION; LARGE AMMONITES FOUND IN CERTAIN LOCALITIES - EQUAL TO PART OR ALL OF CODY SHALE.
	FRONTIER FM	300-600'	MASSIVE GRAY, RESISTANT SANDSTONES INTERCALATED WITH THINLY-BEDDED BROWN SANDY SHALE AND BLACK SHALE; LARGE THREE-FOOT CONCRETIONS NEAR TOP; FEW BEDS OF CHERT-PEBBLE CONGLOMERATE.
	MOWRY SH	350-500'	BROWNISH-GRAY, HARD, RESISTANT SANDSTONE AND SOME BLACK SHALE; NUMEROUS FISH SCALES UP TO ONE AND ONE-HALF INCHES IN LOWER 250 FEET; SIDERITE CONCRETIONS COMMON 150 TO 300 FEET FROM TOP IN BLACK SHALES.
	THERMOPOLIS SH	500-600'	DARK GRAY TO BLACK, THINLY-BEDDED, SOFT SHALES, NON-RESISTANT, INTERBEDDED WITH SEVERAL BENTONITE BEDS; SANDSTONE UNIT BETWEEN TWO AND THREE HUNDRED FEET ABOVE BASE.
	CLOVERLY FM	150-350'	BASAL BLACK CHERT CONGLOMERATES OR PEBBLY, YELLOWISH SANDSTONES; REDDISH SHALES INTERCALATED WITH ANDESITIC AGGLOMERATES AND YELLOW SANDSTONE IN MIDDLE PORTION; GRAY-BROWN SANDSTONE AND SANDY SHALES TOWARD TOP.
JURASSIC	MORRISON FM	200-350'	VARIEGATED REDDISH, GREENISH, PURPLISH, AND GRAY CLAYS AND SHALES INTERBEDDED WITH LIGHT YELLOWISH-GRAY SANDSTONES; RARE OCCURRENCES OF DINOSAUR BONES AND GASTROLITHS.
	SUNDANCE FM	350-600'	BASAL GREEN-BROWN & RED CLAY, SHALES; THIN BEDS OF GYPSUM AND LS; MIDDLE GRAY CLAYS & SANDSTONES WEATHERING GREEN-BROWN; UPPER RESISTANT SS, GLAUCONITIC; COMMON BELEMNITES, CRINOID STEMS, AND THE MOLLUSCS, GRYPHEA
	GYPSUM SPRINGS FM	40-200'	THIN-BEDDED GRAY LIMESTONES AND REDDISH SHALES; THINLY TO MASSIVELY BEDDED GYPSUM TOWARD TOP.
TRIASS.	CHUGWATER FM	180-600'	BRIGHT TO DARK RED SHALES, SILTSTONES, AND SANDSTONES; MUCH GYPSUM SCATTERED IN BASAL TWENTY FEET.
PERM	PARK CITY FM	10-70'	POROUS, THIN-BEDDED, GRAY LIMESTONES; FEW DOLOMITE BEDS AND THIN CALCAREOUS SANDSTONES (=PHOSPHORIA FM)
PENN	TENSLEEP SS	40-240'	GRAY TO TAN, MASSIVE, CROSS-BEDDED, MEDIUM TO COARSE SANDSTONES; RESISTANT TO EROSION; UNFOSSILIFEROUS.
MISSISSIPPIAN	AMSDEN FM	80-140'	RED SHALES AND SILTSTONES WITH INTERCALATED GRAY LIMESTONE AND DOLOMITE; LOCALLY GRAY, CHERTY SANDSTONE.
	MADISON LS	700-800'	CHIEFLY MASSIVE, LIGHT GRAY TO TAN LIMESTONES, COARSELY CRYSTALLINE TO FINE-GRAINED; SOME DOLOMITE AND LOCAL CHERTY ZONES; A FEW THINLY-BEDDED LIMESTONES; A VARIETY OF MARINE INVERTEBRATE FOSSILS FAIRLY COMMON.
DEVONIAN	THREE FORKS FM	70-140'	FLATY, LIGHT GRAY AND YELLOW TO BROWN AND REDDISH LIMESTONE AND DOLOMITE; THICKER CALCAREOUS SANDSTONE AT BASE.
	JEFFERSON LS	220-275'	ALTERNATING THINLY-TO-THICKLY BEDDED LIGHT GRAY TO BROWN LIMESTONES AND DOLOMITES WITH FETID ODOR; FEW FINE BRECCIA BEDS; CALCAREOUS SANDSTONE AT BASE; BRACHIOPODS (ATRYPAS, ETC.) FAIRLY COMMON.
	BEARTOOTH BUTTE FM	8-150'	LOCAL LENSES OF THINLY-BEDDED RED AND BUFF CALCAREOUS SHALES AND THICKER BEDS OF YELLOWISH-WEATHERING, GRAY LIMESTONE AND INTRAFORMATIONAL LIMESTONE CONGLOMERATE; VERY COARSE BASAL CONGLOMERATE; FOSSIL FISHES AND PLANTS.
ORD.	BIGHORN DOLOMITE	150-400'	YELLOWISH-GRAY SANDY DOLOMITE, TEN FEET, OVERLAIN BY MASSIVE, CLIFF-FORMING BUFF, ROUGH WEATHERING DOLOMITE MOTTLED WITH GRAY (170'); THEN LESS RESISTANT, THIN-BEDDED, FINE-GRAINED LIMESTONE WITH RESISTANT DOLOMITE IN MIDDLE. SIXTY FEET THIS UNIT; TOP EIGHTY FEET SAME MASSIVE, MOTTLED DOLOMITE NEAR BOTTOM; FOSSILS RARE.
CAMBRIAN	SNOWY RANGE FM	250-300'	INTERCALATED GREENISH-GRAY SHALES AND INTRAFORMATIONAL CONGLOMERATE; LATTER CONTAINS DISTINCT SUB-ANGULAR, FLAT, GRAY PEBBLES; UPPER FORTY TO FIFTY FEET YELLOW TO GREENISH SHALE, GRAY TO BUFF DOLOMITE AND INTRAFORMATIONAL CONGLOMERATE (= GROVE CREEK MEMBER); PEBBLES WELL-ROUNDED, GRAY WITH GREEN COATING; STAR-SHAPED FOSSILS IN MATRIX.
	MAURICE FM	50-150'	CLIFF-FORMING, THICKLY BEDDED, CRYSTALLINE LIMESTONE, LIGHT GRAY TO BUFF WITH SOME MOTTLING; OCCASIONALLY OOLITIC; TRILOBITE REMAINS COMMON IN COQUINA ABOUT THIRTY FEET ABOVE BASE AND IN TOPMOST BED.
	PARK SH	350-475'	GREENISH TO PURPLE SHALE INTERBEDDED WITH ONE INCH BEDS AND LENSES OF GRAY LIMESTONE; TOP FIFTY FEET CONTAINS DISTINCTIVE EDGEWISE CONGLOMERATES WITH CLASTS AT ALL ANGLES TO BEDDING.
	MEAGHER LS	40-100'	THIN-BEDDED GRAY LIMESTONE, USUALLY IRREGULARLY WAVY-BEDDED; MIDDLE MEMBER, IF PRESENT, MAINLY SOFT, GREEN SHALES.
	WOLSEY SH	50-200'	GREEN, GRAY, PURPLE, PAPERY SHALES GRADING UP TO GREEN, BROWN, SANDY SHALES & SILTSTONES; TRILOBITES FAIRLY COMMON.
	FLATHEAD SS	0-60'	LIGHT TAN TO REDDISH TO WHITE, MEDIUM SANDSTONE, QUARTZITE, LOCALLY CGL; SANDSTONE COARSE & ARKOSIC TOWARD BASE.
PRE-C	"BASEMENT"		COMPLEX OF GRANITIC GNEISSES AND DARK SCHISTS, INTRUDED BY MAFIC DIKES, ETC.

COMPILED BY ERLING DORF
M. B. RAUFFMAN
E. JOHNSON

NOTE: RELATIVE THICKNESSES PROPORTIONAL (APPROXIMATELY TO SCALE) WITHIN EACH ERA BUT NOT BETWEEN ERAS.
TOTAL PALEOZOIC ABOUT 3000'; TOTAL MESOZOIC ABOUT 8500'; TOTAL CENOZOIC ABOUT 13,000' FEET.

1989

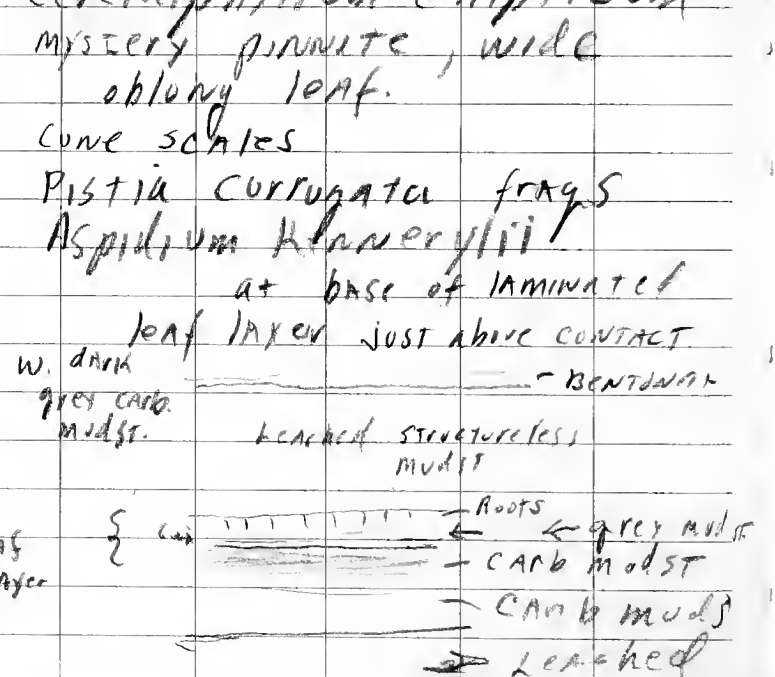


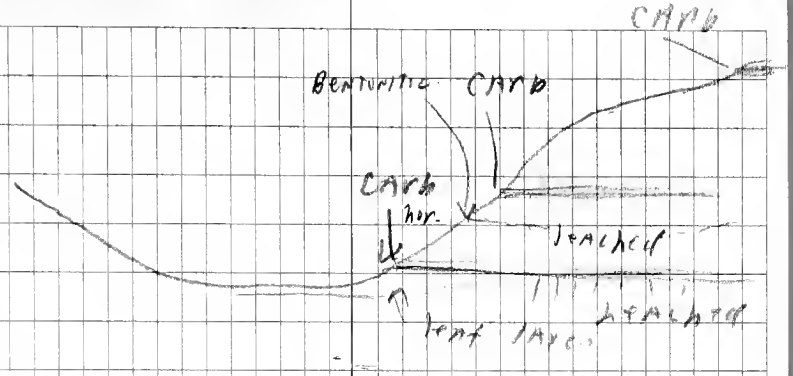
Loc 942
Belleybutton Butte
= loc. 932

Center Sec. 14, T9S, R24E
Carbon Co., Mt.

- Lower meeteetse

Glyptostrobus europaeus
Parataxodium
Platanoids
Cercidiphyllum ellipticum
Mystery pinnate, wide oblong leaf.
Cone scales
Pistia corrugata frags
Aspidium Kanerylii
at base of laminated leaf layer just above contact





942 b 3m S of major pit in swale

VITIS ORIENTALIS

942 C 20 m S of major pit in swale

PARTHENOCISSUS

943 6/30/94

94H 7/1/94

S. ELK-03

Eagle FM, 5m above C SAND
4m below JASON HICKS

44 57 69 N wrong on GPS.
108 50 98 W

NW, NE, Sec 6, T 57 N, R 99 W PARK Co, WY
BENTONITE THAT gave 81Ma
date ~ 10 m below top of
D. and base of Clay Gate.

PLANT SITE.

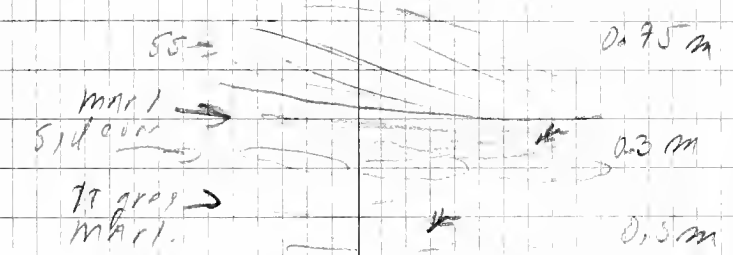
Eagle

at level 87 m in JFH
ELK BASIN Sect.

W. J. HICKS, C. MONTOYA,
D. FULLER, VNA SMITH.

Plants occur on a light grey to buff marl beneath a lt. grey v.f.g. x bedded ss. lens.

Some



Some plants occur in 0.3 m marl interval between ss & silcrete conc's.
Some toward top of the interval below the conc's.

Parataxodium dom.
Crassidenticulum sp.
Elatides (range or poss. non AT wild)
Celastrophyllum.
Few rare additional taxa

944 (CONT.)

Very low diversity.

UNIT PART of a TERRESTRIAL Transgressive pulse - marked by COALIFICATION of depositional area.

UNIT IS a ~~Yellowish~~ light TARNISH grey SL. marly MUDST.

- ~~Very~~ MOSTLY MASSIVE or V. ~~no~~ WEAKLY laminated toward top

PARATAXODIUM IS IN TAXODIOID & CUPRESSOID > CRYPTOMERIOID

CRASSIDENTICULUM of HAS CUTICLE OR IT

PARATAX. becomes more abundant toward top of bed

Census 7/7/96

1 Parataxodium 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸
𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸

2 ~~Emerches~~ 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸
𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸

3 Cercidiphyllum 𝍸 𝍸 𝍸 𝍸
𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 ||

4 Celastrophyllum

Entire marg
5 Winteraceae ? [illegible] 𝍸 𝍸 𝍸 ||||

6 Indet dicot w perc. veins |

7 Indet dicot lvs. |

8 Entire

9 Entire emarginate |||
Citrophyllum

10 aff Lardizabalaceae |

11 Indet obtuse base ent. lf. |||

12 Large broad op Magnoliae
𝍸 |

9+4

0.6 SS. Vfg SY8/1 X-bedded w/ vertical r.p.

0.6 M - 5Y 7/2 Mudst w/ PLANTS

0.25m UNIT becomes a 5Y 5/2 Mudst. at base

up

0.5m COAL

> SS is downcutting at base above. This is 0.14 m of COAL

Inset of the fossil layer digital splay

944

CENSUS EXTENSION

PALAYAN ~~IIII~~ ~~IIII~~ IIII

INTERVAL MEASUREMENT

0 TOP OF "C" SAND

5.5 TO BASE OF FOSSIL BED

+ 5.7 TO JASON & HICKS
STEAK E13B-02 PMA

+ 2.6 TO BENTONITE AT
STEAK E13B 94-9
BENTONITE SAMPLE
GIVES 81.2 Ma DATE

945 7/2/94

Eagle Fm SAME STRAT
& piel as at 944
between C & D SS

NE, NW, NW, Sec 31, T 58N
R 99W, PARK Co. WYO

Elk BASIN 7 1/2' QUAD

Fossils at two levels
one in a clay iron stone
at base of overlying SS 745
& 945b abt 1 1/2 m higher
in next SS.

Palms in level B
Flatides

A level Credneria
PLATANUS guillelmae
Flatides
PARATAXODIUM
Several other dicots.

These are channel margin
units

946 = Loc 8731 7/6/94

Meeteetse dump

NW, NW, NE, Sec 10, T 148N, R 100 W
Park Co., Wyo. Abt 200 Yds E. of Dump

946a Pit 114' East of
MAIN Sample pit
Thuja cf. T.
Taxodium conifer
Picea fragment
Equisetum sp. erose

946b Pond site 10 bentonite
0.3 m above the
lignitic horizon.

- Pond claystone laminated
tanned grey 10 cm
thick
Marchantia!
Equisetum
Pond Scum

w Jill McElderry, Fleur Tiver, Ana, Craig
Van Boskirk, Dorian Fuller, Jory Twist

946c 3M above

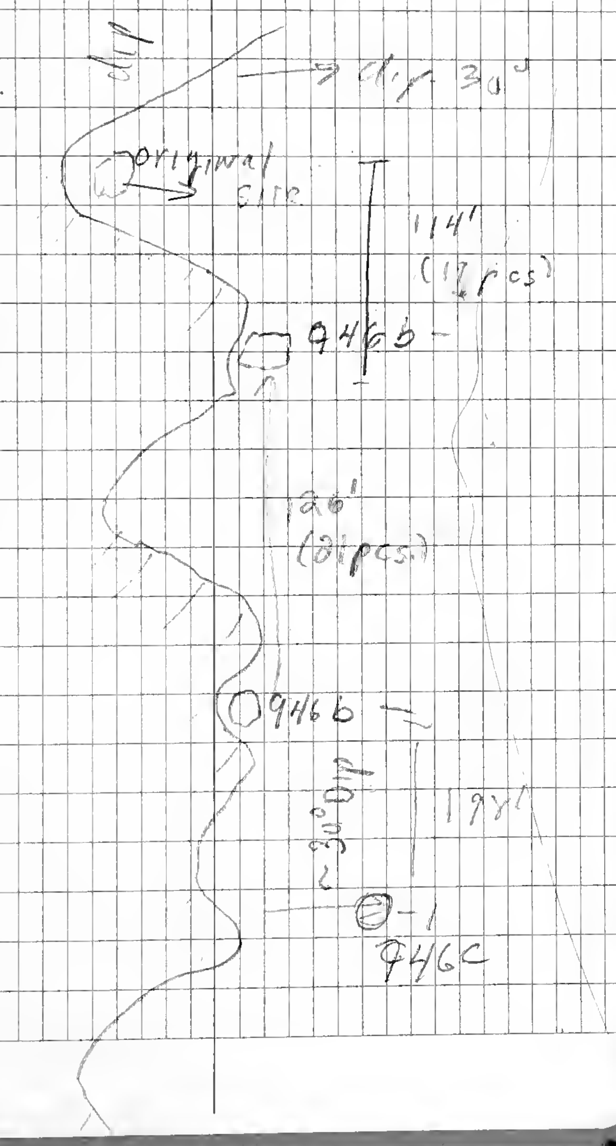
VITIS OLRIKII
TAXOdioid Conifer
Cercidiphyllo id

C' Anemia fremontii below
leaf layer

114
126
198
142
66
180
838

7/6/94

Map view of Meeanmire(?) Dump site
Quarry Dump.



Loc 946 Meetreetse Dump
= Fleur River site
FT 941

946c Basal

- F8
Equisetum
Thujites
F-14 Salpich
Ryfordia
Cladophlebus sp.
Possible Palm or Indet mon
Indet dicot

INCREMENT SECTION 94

0 STARTS AT base of lignite

0.4 Lignite.

1.20 MUDST brown

0.7 Brown Sh.
Fossil plants in laminae
at top in silty
laminae

Quercuxia
Leaves
Insects

Base of this lignite
shenches a channel
DOWNCUTTING by ~~abt~~
2 m. TO THE EAST
CHANNEL STRIKE IS N.E

6.2 m. LT grey laminated SS. in a channel

2.5 m CARB Fissle sh. & interbedded LT grey SS. that thickens into channel axis

channel is a 4 story channel w SS. thickening toward its axis

2.7 LT grey vfg lamin. SS w a 0.3 m fissle carb sh at top

5.85 6.1 m. Ferrug SS representing the b horizon of a stable soil vfg ss. bioturbated rooted.

1.2 m

- 0.45 below Tip becomes SOOTY w/ NUMEROUS ROOTS.

-0.15 m. - brown SOILEY looking ROOTED MUDST w/ CRYPTO-

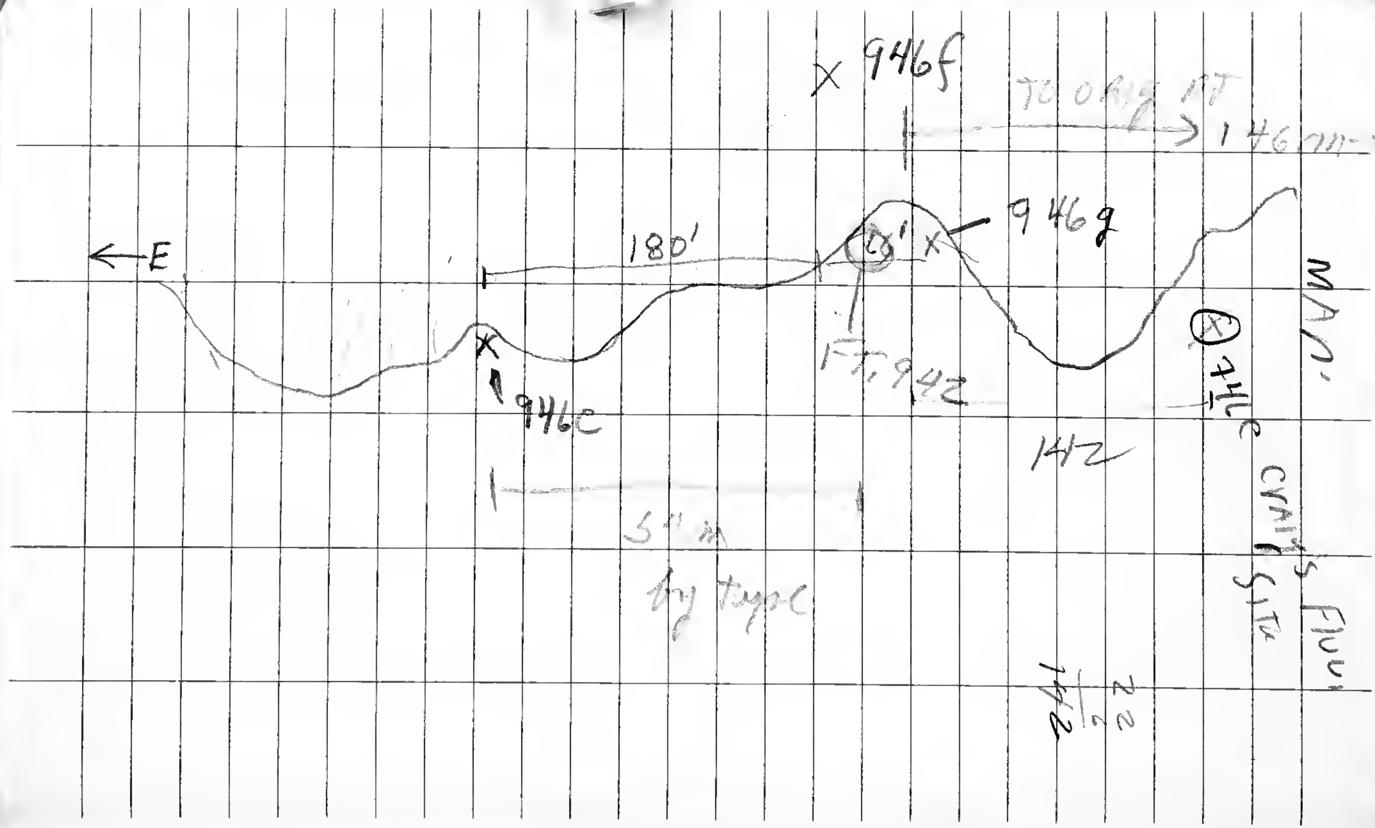
0 m PEAT w TOP 2 cm SILICIFIED

2.2 m Dump BENTONITE

PLANT FOC. 946 E IN BASAL 0.08 km.

0.52 LT GRY VFG LAMINATED SS.

END OF MEASURED SECTION



946f
TO ORIG PT
146
946g
180'
E
946c
FT. 942
142
946e
MAN.
CRAIG'S FLOW
SITE
142
22

7/8/74

Stop GH7

VISION QUEST SECTION

BUTTE at base of JASON HICKS section

- capped by units of the FLUVIAL member of the MEETEETSE Fm. these form the hills south of the Dump site as well.

Gunnera Site
Gunnera City
at JFH loc. 20
SS UNIT.

↑ UNIT 127 of JFH Sec

Gunnera
Monocot
Cercidiphyllum
Nordenskioldia

Probably in NW, NW, NW, Sec 32 T 49N R 100 W, n.w. of Town of Meeteetse, Park Co. Wy. But this is a largely unsurveyed township

Long 108° 34' 36" W, Lat 44° 10' 57" N

Also w/ Filicites Knowltoni (1996)
UNIT appears to be a distal splay SS above a Thin ~~Se~~ lignite, followed by a carb. shale.
Gunnera bearing beds extend some 20 m. to EAST along face of outcrop. (1996 obs.).

949 VISION QUEST VALLEY

BASE of UNIT 140 IN SFH Secr

Pond scds
TAN IMPREGNATED
MUDST W LIMONITE
CRUSTS.

Ficus planicostata
MOULDS
IN
Quereuxia

9410

9411

SCOTTS MIRACLE WONDER LAYER

SALPICH
WOOD.
PALM.
CHAMAEDOREA ELEGANS
BUFFONDIA

VFH UNIT 255 UNDER
POWER LINE
BENTONITE

9 4/2 7/10/94

Big Cedar Village at
10L 36, 36.1, 36.2 again

Cedrid. phyllod
Accr Cret.
Ferns
Elytides

Loc. W Scott Wy

LJH
9412 Green Bug area
Late ? Paleocene ~
40 m below Wo
fauna in basal Willwood
NW, NE, Sec 19, T 46N, R 89W, Washakie Co WYO
Scott Wing Loc 943

Castle Gardens 7/12
NE, NE, NE, Sec 19, T 46 N, R 89W
WASHAKIE Co, WYO
Honeycombs Wilderness Study Area

SLW 9412 Protophyllum or ?
Cercidiphyllum (rare!)
Large Entire EUC AMPT)
Quercus Greenlandica
Plat. cf Raynoldsii
Magnolia nobilis
Ampelopsis acerif
Crevasse Splay or distal spl.

SE, SE, S18, T 46N, R 89W
Loc w Scott Wing.

SLW
9413
Center N 1/4, Sec 19, 46N, R89W.

IN Little Cottonwood Creek
South side of Butte
Flat bedded sandstone w.

Basically same flora as at
SLW 9413

SLW
9412 Ficus planicostata TU505
Dom. Q. groenlandi
Mac Nobilis
Tiliaceous +1
Eucampnia lauraceae TU539

Both SLW 9412 + 9413 are ~40m
below top of Fort Union -
Willwood Contact

JLW
9414

approx ~ 30 m below CONTACT
W. Hillwood.
Center line of N 1/4 Sec
19, etc.
4880 CONTINU
~ 30

PLAT RAYNOLDSII
BETULOID (DOMINANT) FU 503
Thujites INTERRUPTUS
FICUS PLANICOSTATA FU 505
CYCLOCARYA
LAURACEAE FU 539
Tiliaceous leaf
Possible Pterocarya

Loc. 9412 SLW 943

(again)

- PIAT RAYNOLDSII
  PROTOPHYLLUM
  PINNATELY COMPOUND
    PINNULE W ± PINNATE
    LEAF
  METASEQUOIA OCC (1 SPC.)
  TILIACEOUS LEAF TA
  CERCIDIPHYLLUM
  JENKINSELLA
  POPULUS GENETRIX
    FU 539
  CF. ALEURITES
  2 1/2 DAYS COLLECTING
    W/ CREW OF 6.

Loc 94D 7/13/94

Pond in upper Fort Union Fm. & mudstone

BASAL 4 inches a sooty rooted siltstone.

4 inches dense leaf MAT in waxx material

2' interbedded grey mudst siltst w/ interbedded leaves

6' Soil w limonite on bedding planes siltst w fragmentary leaves.

Betula — Entire marg w/ petiole dot

Alnus?

Fern?

at very base Cercidi.

Center S line Sec 18, T41N, R 89 W, Washakie Co.

7/14/94

Drove TO W. of Winifred
MONTANA TO CRAIG
VAN BOSKIRK'S SITES IN
JUDITH RIVER

7/15/94

Visited Three locs in The Judith River Fm. with Craig & VB

VB 9402 Upper Judith River ss. SW, SE, Sec 3, T 22N, R 18E, Fergus Co., MT

- Low Diversity scrappy material in a f.g. ss.
Vitis stantonii
Pistia Elatides

VB 9404 Low Diversity scrappy material in a f.g. ss.
SE, SE, SEC. 1, T 22N, R. 17E
Fergus Co. MT.
Vitis stantonii

VB 9405 Moderate diversity flora in a lt. grey silt st. in ss.
Elatides
Platanus sp.
Piperalean cf. Saururus

PACATAXOL.
CO3 Conifer.
cf. CRASSIDENTICULUM sp.
& Trochodendroid
NOT TRANSported far.

7/16/94 2JH 9413

TRAVERSE TO THE PROMINENT POINT IN SE, SEC 31, T 23 N, R 18 E, Fergus Co., MT.

JUDITH RIVER FM.

BASE IS A SS ABOVE 2750' CONTOUR ABT 10-15 M. THICK. ABOVE THIS SS IS A CARBONACEOUS LAYER PROB. REPRESENTING THE BACK-BARRIER MARSH. THEN A SEQUENCE OF MUDST, SLTST, THIN SS, W CHANNELS, ROOTED INCEPTISOLS, THIN LIGNITES. POOR SCRAPS OF PLANTS ARE RARE.

TOP OF J.R SUPPOSEDLY MARKED BY OYSTER BED THIS OCCURS AT 3250' MAKING J.R 500' THICK

7/16/74

J.B. Quite different in aspect from its occurrence in ELK BASIN.

"Parkman" is a ferruginous ledgy ss that makes a cliff in steep slopes but does not stand out on shallower slopes

Clagget below has no obvious stringer sand "unit" although some sand beds do occur in it.

Also no Ardmore Bentonite in Clagget here. Does have Baculites (determ) The zone

Eagle Top is a white ss forms prominent ledge.

9414

BASALTIC 50' below
TOP of Claggett

9/17/94

Drove to Red Lodge
Through Vigelle, Montana

9/18/94

First day of Elk Basin
familiarization tour w/
Craig VanBoskirk.

Loc 944 7/19/94

Visited again w/ Craig
+ Dorian Fuller

Obtained seeds of
Nordenskiöldia

Loc. 9415

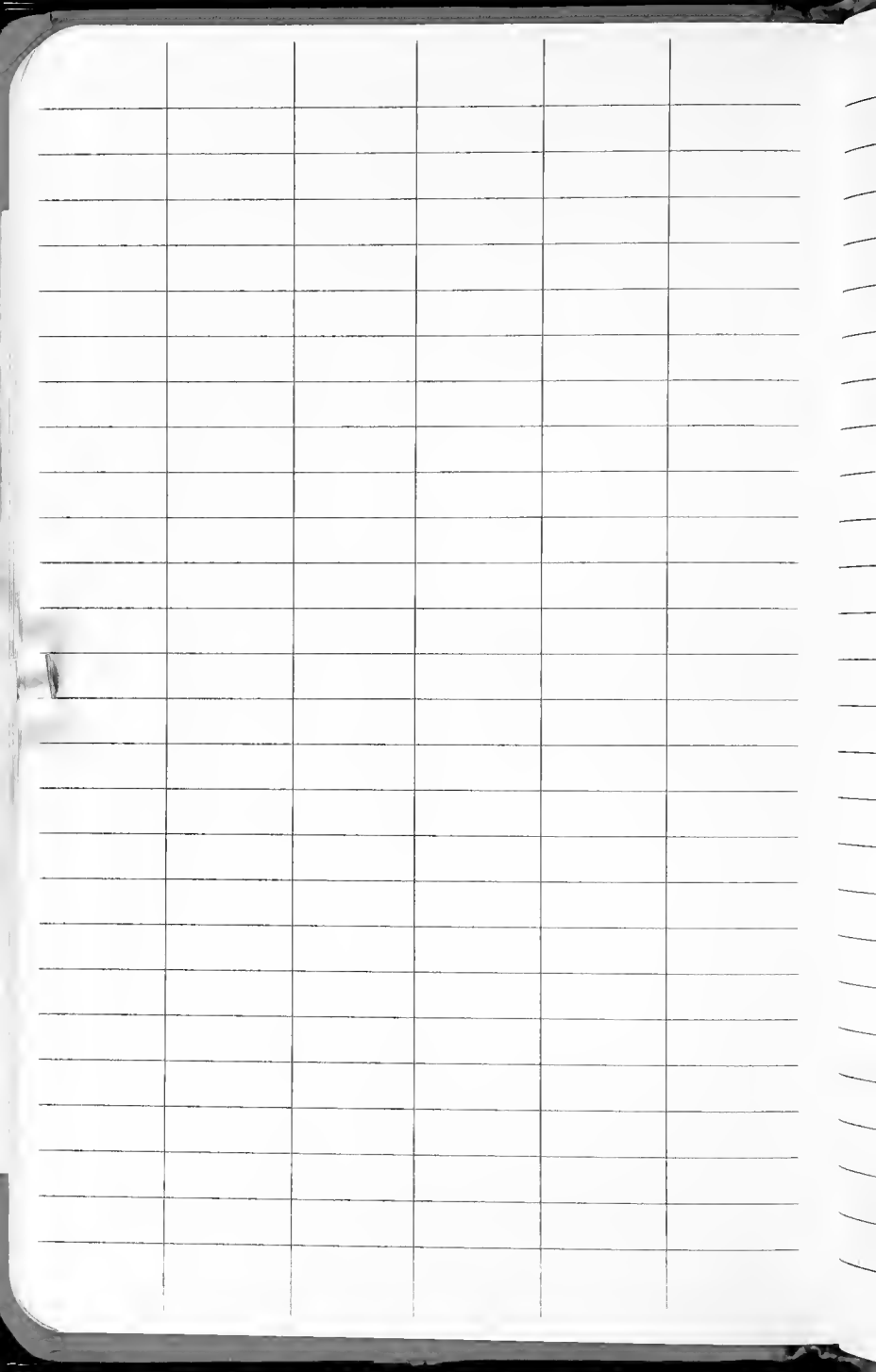
Addy Quarry, Keystone
Luzerne Co. PA

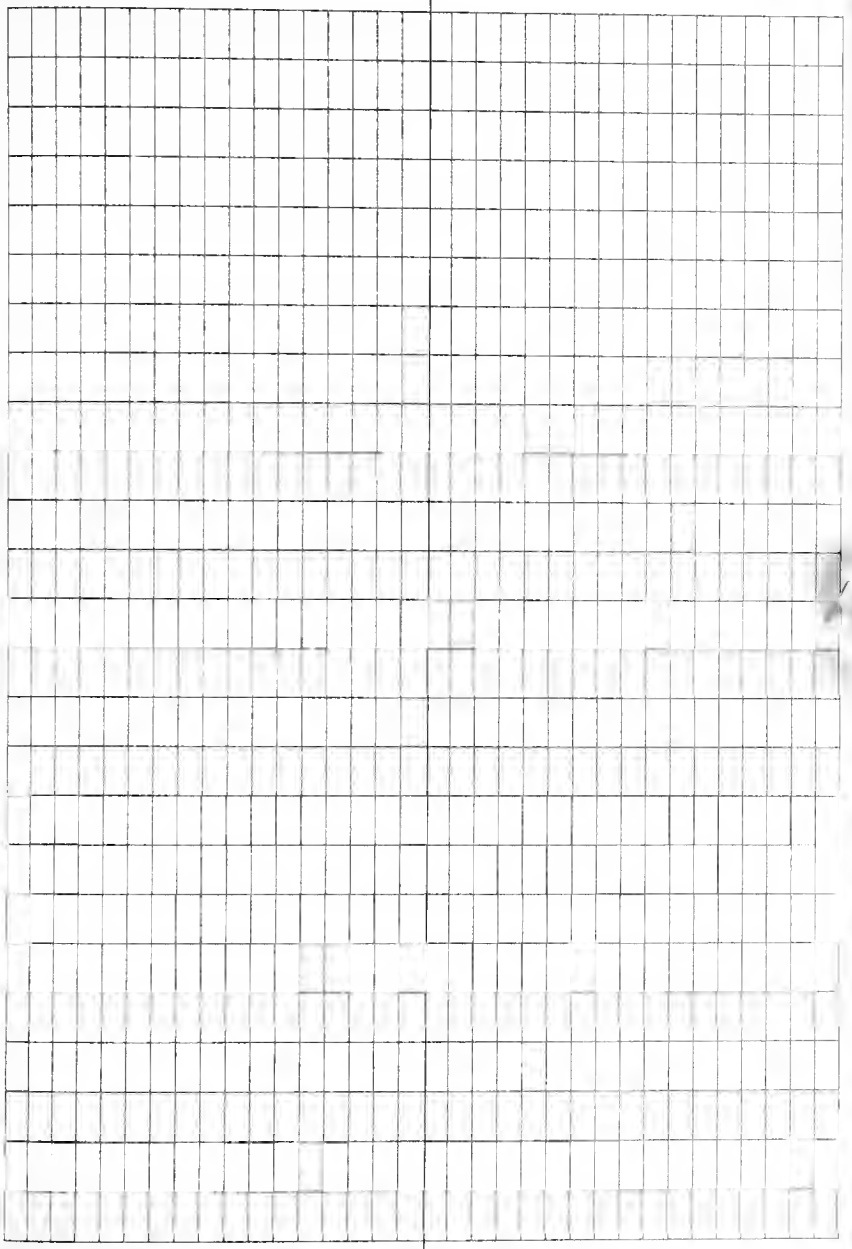
Base of Llewellyn Fm.
From Upper Red Ash
Coal to Moss Coal

- Lycopodiophyta
  - Lycopodiales
    - Lycopodiaceae
      - Lycopodites
  - Isoetales
    - Isoetaceae
      - Isoetites
- Calamites
- Annularia
- Cordaites Leaves
- Diplotheca
- Asterotheca
- Sphenophyllum

Braided Stream env.

- Unit 5 is rooted in
  Stigmaria in upper
  2 m






BIRDS EYE VIEW OF MERRIEETSE, WYO. 99

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U.S. DEPARTMENT OF THE INTERIOR
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NANCY STIMSON

INTERPRETIVE SPECIALIST
Worland District Office

101 S. 23rd St.
P.O. Box 119
Worland, WY 82401

Office: (307) 347-9871
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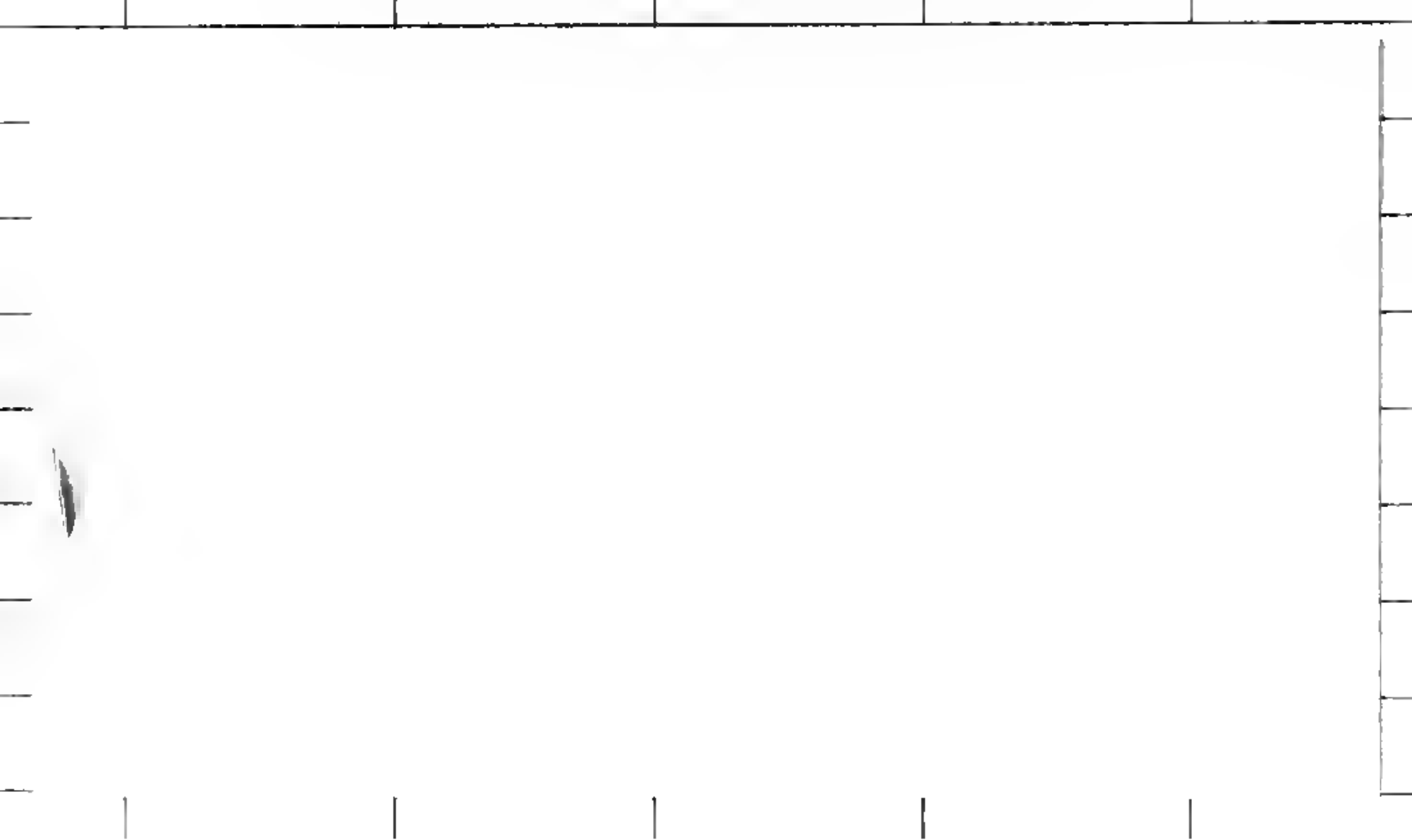


Geologic Map of the
Newton Creek 30' x 60'

Map Series 39 MS-39
1:100,000

Geological Survey of Wyoming
P.O. Box 3008 Univ. Station
Laramie Wy. 82071-3008
(307) 766-2286
FAX (307) 766-2605

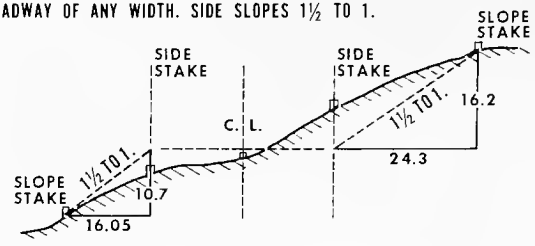
5.00 mailed

INDEX OF
CURVE AND REDUCTION TABLES

TABLE I. SLOPE STAKE

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

ROADWAY OF ANY WIDTH. SIDE SLOPES 1½ TO 1.



Cut or Fill	Distance out from Side or Shoulder Stake.										Cut or Fill
	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	
0	0 00	0 15	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	0
1	1 50	1 65	1 80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	1
2	3.00	3.15	3.30	3 45	3.60	3 75	3.90	4.05	4.20	4 35	2
3	4.50	4 65	4.80	4 95	5 10	5 25	5 40	5.55	5.70	5.85	3
4	6.00	6 15	6.30	6.45	6.60	6 75	6.90	7.05	7.20	7.35	4
5	7 50	7.65	7.80	7.95	8 10	8.25	8.40	8.55	8.70	8.85	5
6	9 00	9 15	9.30	9.45	9.60	9.75	9.90	10.05	10.20	10 35	6
7	10.50	10 65	10 80	10.95	11.10	11.25	11.40	11 55	11 70	11.85	7
8	12.00	12 15	12.30	12.45	12 60	12.75	12.90	13 05	13.20	13.35	8
9	13 50	13 65	13 80	13 95	14.10	14.25	14.40	14 55	14.70	14.85	9
10	15 00	15 15	15 30	15 45	15.60	15.75	15.90	16.05	16.20	16 35	10
11	16 50	16 65	16 80	16.95	17 10	17.25	17.40	17.55	17.70	17.85	11
12	18 00	18 15	18.30	18 45	18 60	18 75	18.90	19.05	19.20	19 85	12
13	19 50	19 65	19.80	19.95	20.10	20.25	20 40	20.55	20.70	20.85	13
14	21.00	21 15	21.30	21.45	21 50	21.75	21.90	22 05	22 20	22 35	14
15	22 50	22 65	22 80	22 95	23.10	23.25	23.40	23.55	23.70	23.85	15
16	24.00	24 15	24 30	24 45	24 60	24.75	24 90	25 05	25.20	25.35	16
17	25.50	25 65	25.80	25 95	26.10	26 25	26 40	26.55	26.70	26.85	17
18	27.00	27 15	27.30	27 45	27.60	27.75	27.90	28 05	28 20	28.35	18
19	28 50	28 65	28 80	28.95	29.10	29.25	29 40	29.55	29.70	29.85	19
20	30 00	30 15	30.30	30.45	30.60	30.75	30.90	31.05	31.20	31.35	20
21	31 50	31 65	31.80	31.95	32 10	32 25	32.40	32.55	32 70	32 85	21
22	33 00	33 15	33 30	33 45	33.60	33 75	33.90	34.05	34.20	34.35	22
23	34 50	34 65	34.80	34.95	35.10	35 25	35 40	35.55	35.70	35 85	23
24	36 00	36 15	36.30	36 45	36.60	36.75	36.90	37.05	37 20	37.35	24
25	37.50	37.65	37 80	37 95	38.10	38.25	38.40	38 55	38.70	38.85	25
26	39 00	39 15	39 30	39 45	39 60	39.75	39.90	40.05	40.20	40.35	26
27	40 50	40 65	40 80	40.95	41.10	41.25	41 40	41.55	41.70	41.85	27
28	42 00	42 15	42 30	42.45	42.60	42 75	42 90	43.05	43 20	43.35	28
29	43 50	43 65	43.80	43 95	44.10	44 25	44 40	44.55	44.70	44 85	29
30	45 00	45 15	45.30	45 45	45.60	45.75	45.90	46.05	46 20	46.35	30
31	46.50	46.65	46.80	46 95	47.10	47.25	47.40	47.55	47.70	47.85	31
32	48 00	48.15	48.30	48 45	48.60	48 75	48.90	49.05	49 20	49.35	32
33	49.50	49 65	49.80	49.95	50.10	50.25	50.40	50.55	50.70	50.85	33
34	51 00	51.15	51.30	51.45	51.60	51.75	51.90	52.05	52.20	52.35	34
35	52 50	52.65	52.80	52.95	53.10	53.25	53.40	53.55	53.70	53.85	35
36	54 00	54.15	54 30	54 45	54.60	54.75	54.90	55.05	55.20	55.35	36
37	55 50	55 65	55.80	55.95	56.10	56.25	56.40	56.55	56.70	56.85	37
38	57.00	57.15	57.30	57 45	57.60	57 75	57.90	58.05	58.20	58 35	38
39	58 50	58.65	58 80	58.95	59.10	59 25	59.40	59 55	59.70	59.85	39
40	60 00	60 15	60 30	60 45	60 60	60.75	60 90	61.05	61 20	61.35	40

TABLE II. STADIA CORRECTION AND HORIZONTAL DISTANCES

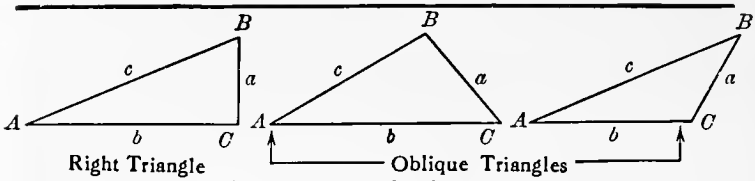
STADIA REDUCTIONS FOR READING 100

Vertical Angle	Horizontal Correction	Difference in Elevation	Vertical Angle	Horizontal Correction	Difference in Elevation
2°—00′	0.1	3.5	18°—30′	10.1	30.1
3°—00′	0.3	5.3	19°—00′	10.6	30.8
4°—00′	0.5	7.0	19°—30′	11.2	31.5
5°—00′	0.8	8.7	20°—00′	11.7	32.1
6°—00′	1.1	10.4	20°—30′	12.3	32.8
7°—00′	1.5	12.1	21°—00′	12.8	33.5
8°—00′	1.9	13.8	21°—30′	13.4	34.1
9°—00′	2.5	15.5	22°—00′	14.0	34.7
10°—00′	3.0	17.10	22°—30′	14.7	35.4
10°—30′	3.3	17.9	23°—00′	15.3	36.0
11°—00′	3.6	18.7	23°—30′	15.9	36.6
11°—30′	4.0	19.5	24°—00′	16.5	37.2
12°—00′	4.3	20.3	24°—30′	17.2	37.7
12°—30′	4.7	21.1	25°—00′	17.9	38.3
13°—00′	5.1	21.9	25°—30′	18.6	39.0
13°—30′	5.5	22.7	26°—00′	19.2	39.4
14°—00′	5.9	23.4	26°—30′	19.9	39.9
14°—30′	6.3	24.2	27°—00′	20.6	40.5
15°—00′	6.7	25.0	27°—30′	21.3	41.0
15°—30′	7.2	25.8	28°—00′	22.0	42.0
16°—00′	7.6	26.5	28°—30′	22.8	41.9
16°—30′	8.1	27.2	29°—00′	23.5	42.4
17°—00′	8.5	28.0	29°—30′	24.3	42.9
17°—30′	9.0	28.7	30°—00′	25.0	43.3
18°—00′	9.5	29.4			

Chains to Feet	
1	66
2	132
3	198
4	264
5	330
6	396
7	462
8	528
9	594
10	660

Feet to Chains	
100	1.515
200	3.030
300	4.545
400	6.060
500	7.575
600	9.090
700	10.606
800	12.121
900	13.636
1,000	15.151

TABLE III. TRIGONOMETRIC FORMULAE



Right Triangle — Oblique Triangles

Solution of Right Triangles

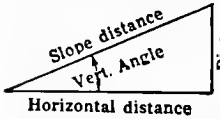
For Angle A. $\sin = \frac{a}{c}$, $\cos = \frac{b}{c}$, $\tan = \frac{a}{b}$, $\cot = \frac{b}{a}$, $\sec = \frac{c}{b}$, $\operatorname{cosec} = \frac{c}{a}$

Given	Required	
a, b	A, B, c	$\tan A = \frac{a}{b} = \cot B, c = \sqrt{a^2 + b^2} = a\sqrt{1 + \frac{b^2}{a^2}}$
a, c	A, B, b	$\sin A = \frac{a}{c} = \cos B, b = \sqrt{(c+a)(c-a)} = c\sqrt{1 - \frac{a^2}{c^2}}$
A, a	B, b, c	$B = 90° - A, b = a \cot A, c = \frac{a}{\sin A}$
A, b	B, a, c	$B = 90° - A, a = b \tan A, c = \frac{b}{\cos A}$
A, c	B, a, b	$B = 90° - A, a = c \sin A, b = c \cos A$,

Solution of Oblique Triangles

Given	Required	
A, B, a	b, c, C	$b = \frac{a \sin B}{\sin A}$, $C = 180° - (A + B)$, $c = \frac{a \sin C}{\sin A}$
A, a, b	B, c, C	$\sin B = \frac{b \sin A}{a}$, $C = 180° - (A + B)$, $c = \frac{a \sin C}{\sin A}$
a, b, C	A, B, c	$A + B = 180° - C$, $\tan \frac{1}{2}(A - B) = \frac{(a-b)\tan \frac{1}{2}(A+B)}{a+b}$. $c = \frac{a \sin C}{\sin A}$
a, b, c	A, B, C	$s = \frac{a+b+c}{2}$, $\sin \frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{bc}}$, $\sin \frac{1}{2}B = \sqrt{\frac{(s-a)(s-c)}{ac}}$, $C = 180° - (A+B)$
a, b, c	Area	$s = \frac{a+b+c}{2}$, area $= \sqrt{s(s-a)(s-b)(s-c)}$
A, b, c	Area	area $= \frac{b c \sin A}{2}$
A, B, C, a	Area	area $= \frac{a^2 \sin B \sin C}{2 \sin A}$

REDUCTION TO HORIZONTAL



Horizontal distance = Slope distance multiplied by the cosine of the vertical angle. Thus: slope distance = 319.4 ft. Vert. angle = 5° 10′. From Table, IV. cos 5° 10′ = 9959. Horizontal distance = 319.4 × .9959 = 318.09 ft.

Horizontal distance also = Slope distance minus slope distance times (1 − cosine of vertical angle). With the same figures as in the preceding example, the following result is obtained. Cosine 5° 10′ = .9959. 1 − .9959 = .0041. 319.4 × .0041 = 1.31. 319.4 − 1.31 = 318.09 ft.

When the rise is known, the horizontal distance is approximately: — the slope distance less the square of the rise divided by twice the slope distance. Thus: rise = 14 ft., slope distance = 302.6 ft. Horizontal distance $= 302.6 - \frac{14 \times 14}{2 \times 302.6} = 302.6 - 0.32 = 302.28$ ft.

TABLE IV. NATURAL TRIGONOMETRICAL FUNCTIONS

Angle	Sin	Tan.	Sec.	Cosec.	Cotg.	Cosin.	
° ′							
0	0	0	1.	∞	∞	1.	90
10	.0029	.0029		343.8	343.8	1.	50
20	.0058	.0058		171.9	171.9	.99998	40
30	.0087	.0087		114.6	114.6	.99996	30
40	.0116	.0116	1.0001	85.94	85.94	.99993	20
50	.0145	.0145	1.0001	68.76	68.75	.99989	10
1	.0175	.0175	1.0002	57.30	57.29	.99985	89
10	.0204	.0204	1.0002	49.11	49.10	.99979	50
20	.0233	.0233	1.0003	42.98	42.96	.99973	40
30	.0262	.0262	1.0003	38.20	38.19	.99966	30
40	.0291	.0291	1.0004	34.38	34.37	.99958	20
50	.0320	.0320	1.0005	31.26	31.24	.99949	10
2	.0349	.0349	1.0006	28.65	28.64	.99939	88
10	.0378	.0378	1.0007	26.45	26.43	.99929	50
20	.0407	.0407	1.0008	24.56	24.54	.99917	40
30	.0436	.0437	1.0010	22.93	22.90	.99905	30
40	.0465	.0466	1.0011	21.49	21.47	.99892	20
50	.0494	.0495	1.0012	20.23	20.21	.99878	10
3	.0523	.0524	1.0014	19.11	19.08	.99863	87
10	.0552	.0553	1.0015	18.10	18.07	.99847	50
20	.0581	.0582	1.0017	17.20	17.17	.99831	40
30	.0610	.0612	1.0019	16.38	16.35	.99813	30
40	.0640	.0641	1.0020	15.64	15.60	.99795	20
50	.0669	.0670	1.0022	14.96	14.92	.99776	10
4	.0698	.0699	1.0024	14.34	14.30	.99756	86
10	.0727	.0729	1.0027	13.76	13.73	.99736	50
20	.0756	.0758	1.0029	13.23	13.20	.99714	40
30	.0785	.0787	1.0031	12.75	12.71	.99692	30
40	.0814	.0816	1.0033	12.29	12.25	.99668	20
50	.0843	.0846	1.0036	11.87	11.83	.99644	10
5	.0872	.0875	1.0038	11.47	11.43	.99619	85
10	.0901	.0904	1.0041	11.10	11.06	.99594	50
20	.0929	.0934	1.0043	10.76	10.71	.99567	40
30	.0958	.0963	1.0046	10.43	10.39	.99540	30
40	.0987	.0992	1.0049	10.13	10.08	.99511	20
50	.1016	.1022	1.0052	9.839	9.788	.99482	10
6	.1045	.1051	1.0055	9.567	9.514	.99452	84
10	.1074	.1080	1.0058	9.309	9.255	.99421	50
20	.1103	.1110	1.0061	9.065	9.010	.99390	40
30	.1132	.1139	1.0065	8.834	8.777	.99357	30
40	.1161	.1169	1.0068	8.614	8.556	.99324	20
50	.1190	.1198	1.0072	8.405	8.345	.99290	10
7	.1219	.1228	1.0075	8.206	8.144	.99255	83
10	.1248	.1257	1.0079	8.016	7.953	.99219	50
20	.1276	.1287	1.0082	7.834	7.770	.99182	40
30	.1305	.1317	1.0086	7.661	7.596	.99144	30
40	.1334	.1346	1.0090	7.496	7.429	.99106	20
50	.1363	.1376	1.0094	7.337	7.269	.99067	10
							82
							° ′
	Cosin	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle

Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.	
° ′							
8	.1392	.1405	1.0098	7.185	7.115	.99027	82
10	.1421	.1435	1.0102	7.040	6.968	.98986	50
20	.1449	.1465	1.0107	6.900	6.827	.98944	40
30	.1478	.1495	1.0111	6.766	6.691	.98902	30
40	.1507	.1524	1.0115	6.636	6.561	.98858	20
50	.1536	.1554	1.0120	6.512	6.435	.98814	10
9	.1564	.1584	1.0125	6.394	6.314	.98769	81
10	.1593	.1614	1.0129	6.277	6.197	98723	50
20	.1622	.1644	1.0134	6.166	6.084	.98676	40
30	.1650	.1673	1.0139	6.059	5.976	.98629	30
40	.1679	.1703	1.0144	5.955	5.871	.98580	20
50	.1708	.1733	1.0149	5.855	5.769	.98531	10
10	.1736	.1763	1.0154	5.759	5.671	.98481	80
10	.1765	.1793	1.0160	5.665	5.576	.98430	50
20	.1794	.1823	1.0165	5.575	5.485	.98378	40
30	.1822	.1853	1.0170	5.488	5.396	.98325	30
40	.1851	.1883	1.0176	5.403	5.309	.98272	20
50	.1880	.1914	1.0181	5.320	5.226	.98218	10
11	.1908	.1944	1.0187	5.241	5.145	.98163	79
10	.1937	.1974	1.0193	5.164	5.066	.98107	50
20	.1965	.2004	1.0199	5.089	4.989	.98050	40
30	.1994	.2035	1.0205	5.016	4.915	.97992	30
40	.2022	.2065	1.0211	4.945	4.843	.97934	20
50	.2051	.2095	1.0217	4.877	4.773	.97875	10
12	.2079	.2126	1.0223	4.810	4.705	.97815	78
10	.2108	.2156	1.0230	4.745	4.638	.97754	50
20	.2136	.2186	1.0236	4.682	4.574	.97692	40
30	.2164	.2217	1.0243	4.620	4.511	.97630	30
40	.2193	.2247	1.0249	4.560	4.449	.97566	20
50	.2221	.2278	1.0256	4.502	4.390	.97502	10
13	.2250	.2309	1.0263	4.445	4.331	.97437	77
10	.2278	.2339	1.0270	4.390	4.275	.97371	50
20	.2306	.2370	1.0277	4.336	4.219	.97304	40
30	.2334	.2401	1.0284	4.284	4.165	.97237	30
40	.2363	.2432	1.0291	4.232	4.113	.97169	20
50	.2391	.2462	1.0299	4.182	4.061	.97100	10
14	.2419	.2493	1.0306	4.133	4.011	.97030	76
10	.2447	.2524	1.0314	4.086	3.962	.96959	50
20	.2476	.2555	1.0321	4.039	3.914	.96887	40
30	.2504	.2586	1.0329	3.994	3.867	.96815	30
40	.2532	.2617	1.0337	3.949	3.821	.96742	20
50	.2560	.2648	1.0345	3.906	3.776	.96667	10
15	.2588	.2679	1.0353	3.864	3.732	.96593	75
10	.2616	.2711	1.0361	3.822	3.689	.96517	50
20	.2644	.2742	1.0369	3.782	3.647	.96440	40
30	.2672	.2773	1.0377	3.742	3.606	.96363	30
40	.2700	.2805	1.0386	3.703	3.566	.96285	20
50	.2728	.2836	1.0394	3.665	3.526	.96206	10
							74
							° ′
	Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle

TABLE IV CONTD. NATURAL TRIGONOMETRICAL FUNCTIONS

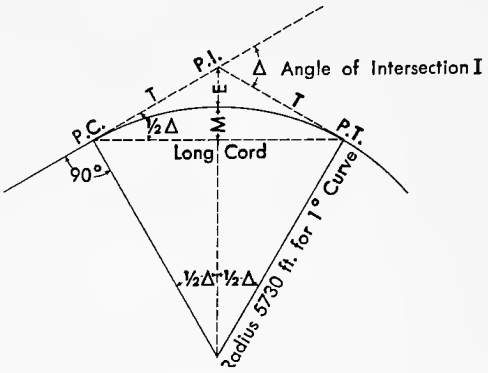
Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.		Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.	
° ′								° ′							
16	.2756	.2867	1.0403	3.628	3.487	.96126	**74**	**24**	.4067	.4452	1.0946	2.459	2.246	.91355	**66**
10	.2784	.2899	1.0412	3.592	3.450	.96046	50	10	.4094	.4487	1.0961	2.443	2.229	91236	50
20	.2812	.2931	1.0423	3.556	3.412	.95964	40	20	.4120	.4522	1.0975	2.427	2.211	.91116	40
30	.2840	.2962	1.0429	3.521	3.376	.95882	30	30	.4147	.4557	1.0989	2.411	2.194	.90996	30
40	.2868	2994	1.0438	3.487	3.340	.95799	20	40	.4173	.4592	1.1004	2.396	2.177	.90875	20
50	.2896	.3026	1.0448	3.453	3.305	.95715	10	50	.4200	.4628	1,1019	2.381	2.161	.90753	10
17	.2924	.3057	1.0457	3.420	3.271	.95630	**73**	**25**	.4226	.4663	1.1034	2.366	2.145	.90631	**65**
10	.2952	.3089	1.0466	3.388	3.237	95545	50	10	.4253	.4699	1.1049	2.351	2.128	.90507	50
20	.2979	3121	1.0476	3.357	3.204	.95459	40	20	.4279	.4734	1.1064	2.337	2.112	.90383	40
30	.3007	.3153	1.0485	3.326	3.172	.95372	30	30	.4305	.4770	1 1079	2.323	2.097	90259	30
40	.3035	3185	1.0495	3.295	3.140	.95284	20	40	.4331	.4806	1.1095	2.309	2.081	.90133	20
50	.3062	.3217	1.0505	3.265	3.108	.95195	10	50	.4358	.4841	1.1110	2.295	2.066	90007	10
18	.3090	.3249	1.0515	3.236	3.078	.95106	**72**	**26**	.4384	.4877	1.1126	2.281	2.050	.89879	**64**
10	.3118	.3281	1.0525	3.207	3.048	.95015	50	10	.4410	.4913	1 1142	2.268	2.035	.89752	50
20	.3145	.3314	1.0535	3.179	3.018	.94924	40	20	.4436	.4950	1.1158	2.254	2.020	.89623	40
30	.3173	.3346	1.0545	3.152	2.989	94832	30	30	.4462	4986	1.1174	2.241	2.006	89493	30
40	.3201	.3378	1.0555	3.124	2.960	.94740	20	40	.4488	.5022	1.1190	2.228	1.991	.89363	20
50	.3228	.3411	1.0566	3.098	2.932	.94646	10	50	.4514	.5059	1.1207	2.215	1.977	89232	10
19	.3256	.3443	1.0576	3.072	2.904	.94552	**71**	**27**	.4540	.5095	1.1223	2.203	1.963	.89101	**63**
10	.3283	.3476	1.0587	3.046	2.877	94457	50	10	.4566	.5132	1.1240	2.190	1.949	.88968	50
20	.3311	3508	1.0598	3.020	2.850	.94361	40	20	.4592	.5169	1.1257	2.178	1.935	.88835	40
30	.3338	.3541	1.0608	2.996	2.824	.94264	30	30	.4617	.5206	1 1274	2.166	1.921	.88701	30
40	.3365	.3574	1.0619	2.971	2.798	.94167	20	40	.4643	.5243	1.1291	2.154	1.907	.88566	20
50	.3393	.3607	1.0631	2.947	2.773	.94068	10	50	.4669	.5280	1.1308	2.142	1.894	88431	10
20	.3420	.3640	1.0642	2.924	2.747	.93969	**70**	**28**	.4695	.5317	1.1326	2.130	1.881	.88295	**62**
10	.3448	.3673	1.0653	2.900	2.723	93869	50	10	.4720	.5354	1 1343	2.119	1.868	88158	50
20	.3475	.3706	1.0665	2.878	2.699	.93769	40	20	.4746	.5392	1.1361	2.107	1.855	.88020	40
30	.3502	.3739	1.0676	2.856	2.675	.93667	30	30	.4772	.5430	1.1379	2.096	1.842	87882	30
40	.3529	.3772	1.0688	2.833	2.651	.93565	20	40	.4797	.5467	1.1397	2.085	1.829	.87743	20
50	.3557	.3805	1.0700	2.811	2.628	.93462	10	50	.4823	.5505	1.1415	2.073	1.816	87603	10
21	.3584	.3839	1.0711	2.790	2.605	.93358	**69**	**29**	.4848	.5543	1.1434	2.063	1.804	.87462	**61**
10	.3611	.3872	1.0723	2.769	2.583	93253	50	10	.4874	.5581	1.1452	2.052	1.792	.87321	50
20	.3638	.3906	1.0736	2.749	2.560	.93148	40	20	.4899	.5619	1.1471	2.041	1.780	.87178	40
30	.3665	.3939	1.0748	2.729	2.539	.93042	30	30	.4924	.5658	1.1490	2.031	1.767	.87036	30
40	.3692	.3973	1.0760	2.709	2.517	.92935	20	40	.4950	.5696	1,1509	2.020	1.756	.86892	20
50	.3719	.4006	1.0773	2.689	2.496	92827	10	50	.4975	.5735	1.1528	2.010	1.744	.86748	10
22	.3746	.4040	1.0785	2.670	2.475	.92718	**68**	**30**	.5000	.5774	1.1547	2.000	1.732	.86603	**60**
10	.3773	.4074	1.0798	2.650	2.455	.92609	50	10	.5025	.5812	1 1566	1.990	1.720	.86457	50
20	.3800	.4108	1.0811	2.632	2.434	.92499	40	20	.5050	.5851	1.1586	1.980	1.709	.86310	40
30	.3827	.4142	1.0824	2.613	2.414	92388	30	30	.5075	.5890	1.1606	1.970	1.698	.86163	30
40	.3854	.4176	1.0837	2.595	2.394	.92276	20	40	.5100	.5930	1.1626	1.961	1.686	.86015	20
50	.3881	.4210	1 0850	2.577	2.375	92164	10	50	.5125	.5969	1.1646	1.951	1.675	85866	10
23	.3907	.4245	1.0864	2.559	2.356	.92050	**67**	31	5150	.6009	1.1666	1.924	1.664	.85717	**59**
10	.3934	.4279	1.0877	2.542	2.337	.91936	50	10	.5175	.6048	1.1687	1.932	1.653	.85567	50
20	.3961	.4314	1.0891	2.525	2.318	.91822	40	20	.5200	.6088	1.1707	1.923	1.643	.85416	40
30	.3987	.4348	1.0904	2.508	2.300	.91706	30	30	.5225	.6128	1 1728	1.914	1.632	.85264	30
40	.4014	.4383	1.0918	2.491	2.282	.91590	20	40	.5250	.6168	1.1749	1.905	1.621	.85112	20
50	.4041	.4417	1.0932	2.475	2.264	.91472	10	50	.5275	.6208	1.1770	1.896	1.611	84959	10
							66								**58**
							° ′								° ′
	Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle		Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle

TABLE IV CONTD. NATURAL TRIGONOMETRICAL FUNCTIONS

Angle	Sin.	Tan.	Sec.	Cosec.	Cotg.	Cosin.		Angle	Sin.	Tan	Sec.	Cosec.	Cotg.	Cosin.	
° ′							° ′	° ′							° ′
32	.5299	.6249	1.1792	1.887	1.600	.84805	58	39	.6293	.8098	1.2868	1.589	1.235	.77715	51
10	.5324	.6289	1.1813	1.878	1.590	.84650	50	10	.6316	.8146	1.2898	1.583	1.228	.77531	50
20	.5348	.6330	1.1835	1.870	1.580	.84495	40	20	.6338	.8195	1.2929	1.578	1.220	.77347	40
30	.5373	.6371	1.1857	1.861	1.570	.84339	30	30	.6361	.8243	1.2959	1.572	1.213	.77162	30
40	.5398	.6412	1.1879	1.853	1.560	.84182	20	40	.6383	.8292	1.2991	1.567	1.206	.76977	20
50	.5422	.6453	1.1901	1.844	1.550	84025	10	50	.6406	.8342	1.3022	1.561	1.199	.76791	10
33	.5446	.6494	1.1924	1.836	1.540	.83867	57	40	.6428	.8391	1.3054	1.556	1.192	.76604	50
10	.5471	.6536	1.1946	1.828	1.530	.83708	50	10	.6450	.8441	1.3086	1.550	1.185	.76417	50
20	.5495	.6577	1.1969	1.820	1.520	.83549	40	20	.6472	.8491	1.3118	1.545	1.178	.76229	40
30	.5519	.6619	1.1992	1.812	1.511	.83389	30	30	.6494	.8541	1.3151	1.540	1.171	.76041	30
40	.5544	.6661	1.2015	1.804	1.501	.83228	20	40	.6517	.8591	1.3184	1.535	1.164	.75851	20
50	.5568	.6703	1 2039	1.796	1.492	.83066	10	50	.6539	.8642	1.3217	1.529	1.157	.75661	10
34	.5592	.6745	1.2062	1.788	1.483	.82904	56	41	.6561	.8693	1.3251	1.524	1.150	.75471	49
10	.5616	.6787	1.2086	1.781	1.473	.82741	50	10	.6583	.8744	1.3284	1.519	1.144	.75280	50
20	.5640	.6830	1.2110	1.773	1.464	.82577	40	20	.6604	.8796	1.3318	1.514	1.137	.75088	40
30	.5664	.6873	1.2134	1.766	1.455	.82413	30	30	.6626	.8847	1.3352	1.509	1.130	.74896	30
40	.5688	.6916	1.2158	1.758	1.446	.82248	20	40	.6648	.8899	1.3386	1.504	1.124	.74703	20
50	.5712	.6959	1.2183	1.751	1.437	.82082	10	50	.6670	.8952	1.3421	1.499	1.117	.74509	10
35	.5736	.7002	1.2208	1.743	1.428	.81915	55	42	.6691	.9004	1.3456	1.494	1.111	.74314	48
10	.5760	.7046	1.2233	1.736	1.419	.81748	50	10	.6713	.9057	1.3492	1.490	1.104	.74120	50
20	.5783	.7089	1.2258	1.729	1.411	.81580	40	20	.6734	.9110	1.3527	1.485	1.098	.73924	40
30	.5807	.7133	1 2283	1.722	1.402	.81412	30	30	.6756	.9163	1.3563	1.480	1.091	.73728	30
40	.5831	.7177	1.2309	1.715	1.393	.81242	20	40	.6777	.9217	1.3600	1.476	1.085	.73531	20
50	.5854	.7221	1.2335	1.708	1.385	.81072	10	50	.6799	.9271	1.3636	1.471	1.079	.73333	10
36	.5878	.7265	1.2361	1.701	1.376	.80902	54	43	.6820	.9325	1.3673	1.466	1.072	.73135	47
10	.5901	.7310	1.2387	1.695	1.368	80730	50	10	.6841	.9380	1.3711	1.462	1.066	.72937	50
20	.5925	.7355	1.2413	1.688	1.360	.80558	40	20	.6862	.9435	1 3748	1.457	1.060	.72737	40
30	.5948	.7400	1 2440	1.681	1.351	.80386	30	30	.6884	.9490	1.3786	1.453	1.054	.72537	30
40	.5972	.7445	1.2466	1.675	1.343	.80212	20	40	.6905	.9545	1.3824	1.448	1.048	.72337	20
50	.5995	.7490	1.2494	1.668	1.335	.80038	10	50	.6926	.9601	1.3863	1.444	1.042	.72136	10
37	.6018	.7536	1.2521	1.662	1.327	.79864	53	44	.6947	.9657	1.3902	1.440	1.036	.71934	46
10	.6041	.7581	1.2549	1.655	1.319	.79688	50	10	.6967	.9713	1.3941	1.435	1.030	.71732	50
20	.6065	.7627	1.2577	1.649	1.311	.79512	40	20	.6988	.9770	1.3980	1.431	1.024	.71529	40
30	.6088	.7673	1.2605	1.643	1.303	.79335	30	30	.7009	.9827	1.4020	1.427	1.018	.71325	30
40	.6111	.7720	1.2633	1.636	1.295	.79158	20	40	.7030	.9884	1.4061	1.422	1.012	.71121	20
50	.6134	.7766	1 2661	1.630	1.288	.78980	10	50	.7050	.9942	1.4101	1.418	1.006	.70916	10
38	.6157	.7813	1.2690	1.624	1.280	.78801	52		.7071	1.	1.414	1.414	1.	.70711	45
10	.6180	.7860	1.2719	1.618	1.272	.78622	50								
20	.6202	.7907	1.2748	1.612	1.265	.78442	40								
30	.6225	.7954	1.2778	1.606	1.257	.78261	30								
40	.6248	.8002	1.2808	1.601	1.250	.78079	20								
50	.6271	.8050	1,2838	1,595	1.242	.77897	10								
	Cosin.	Cotg.	Cosec.	Sec.	Tan.	Sin.	Angle		Cosin.	Cotg.	Cosec.	Sec.	Ton.	Sin.	Angle

CURVE TABLE

Table of Tangent and External to a 1° Curve



To find Tangent and External for curve of any other degree, divide by degree of curve and add correction found in column of corrections.

Degree of curve with a given I may be found by dividing tangent, (or external), opposite I by given tangent, (or external).

The distance from a point on the tangent to the curve is very nearly the square of the tangent length divided by twice the radius.

CURVE FORMULAS

Radius: $R = \frac{50}{\sin \frac{1}{2} D}$

Length of Curve: $L = 100 \frac{\Delta}{D}$

also $L = .0174533 \times \Delta \times R$

Degree of Curve: $D = 100 \frac{\Delta}{L}$

Tangent: $T = R \tan \frac{1}{2} \Delta$

Long Cord: $LC = 2R \sin \frac{1}{2} \Delta$

Middle Ordinate: $M = R\ (1 - \text{Cos}\ \frac{1}{2}\ \Delta)$

External: $E = T \tan \frac{1}{4} \Delta$

TABLE V. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=10°	I	T	E	I=20°	I	T	E	I=30°
1°	50.00	.218	+	11°	551.70	26.500	+	21°	1061.9	97.577	+
10′	58.34	.297	5° C.	10′	560.11	27.313	5° C.	10′	1070.6	99.155	5° C.
20′	66.67	.388	T	20′	568.53	28.137	T	20′	1079.2	100.75	T
30′	75.01	.491	.03	30′	576.95	28.974	.06	30′	1087 8	102.35	.10
40′	83.34	.606	E	40′	585.36	29.824	E	40′	1096.4	103.97	E
50′	91.68	.733	.001	50′	593.79	30.686	.006	50′	1105.1	105.60	.013
2°	100.01	.873		12°	602.21	31.561		22°	1113.7	107.24	
10′	108.35	1.024		10′	610.64	32.447		10′	1122.4	108.90	
20′	116.68	1.188		20′	619.07	33.347		20′	1131.0	110.57	
30′	125.02	1.364		30′	627.50	34.259		30′	1139.7	112.25	
40′	133.36	1.552		40′	635.93	35.183		40′	1148.4	113.95	
50′	141.70	1.752		50′	644.37	36.120		50′	1157.0	115.66	
3°	150.04	1.964	10° C.	13°	652.81	37.070	10° C.	23°	1165.7	117.38	10° C.
10′	158.38	2.188	T	10′	661.25	38.031	T	10′	1174.4	119.12	T
20′	166.72	2.425	.06	20′	669.70	39.006	.13	20′	1183.1	120.87	.19
30′	175.06	2.674	E	30′	678.15	39.993	E	30′	1191.8	122.63	E
40′	183.40	2.934	.003	40′	686.60	40.992	.011	40′	1200.5	124.41	.025
50′	191.74	3.207		50′	695.06	42.004		50′	1209.2	126.20	
4°	200.08	3.492		14°	703.51	43.029		24°	1217.9	128.00	
10′	208.43	3.790		10′	711.97	44.066		10′	1226.6	129.82	
20′	216.77	4.099		20′	720.44	45.116		20′	1235.3	131.65	
30′	225.12	4.421		30′	728.90	46.178		30′	1244.0	133.50	
40′	233.47	4.755		40′	737.37	47.253		40′	1252.8	135.35	
50′	241.81	5.100	15° C.	50′	745.85	48.341	15° C.	50′	1261.5	137.23	15° C.
5°	250.16	5.459	T	15°	754.32	49.441	T	25°	1270.2	139.11	T
10′	258.51	5.829	.09	10′	762.80	50.554	.19	10′	1279.0	141.01	.29
20′	266.86	6.211	E	20′	771.29	51.679	E	20′	1287.7	142.93	E
30′	275.21	6.606	.004	30′	779.77	52.818	.017	30′	1296.5	144.85	.038
40′	283.57	7.013		40′	788.26	53.969		40′	1305.3	146.79	
50′	291.92	7.432		50′	796.75	55.132		50′	1314.0	148.75	
6°	300.28	7.863		16°	805.25	56.309		26°	1322.8	150.71	
10′	308.64	8.307		10′	813.75	57.498		10′	1331.6	152.69	
20′	316.99	8.762		20′	822.25	58.699		20′	1340.4	154.69	
30′	325.35	9.230		30′	830.76	59.914		30′	1349.2	156.70	
40′	333.71	9.710	20° C.	40′	839.27	61.141	20° C.	40′	1358.0	158.72	20° C.
50′	342.08	10.202	T	50′	847.78	62.381	T	50′	1366.8	160.76	T
7°	350.44	10.707	.13	17°	856.30	63.634	.26	27°	1375.6	162.81	.39
10′	358.81	11.224	E	10′	864.82	64.900	E	10′	1384.4	164.86	E
20′	367.17	11.753	.006	20′	873.35	66.178	.022	20′	1393.2	166.95	.051
30′	375.54	12.294		30′	881.88	67.470		30′	1402.0	169.04	
40′	383.91	12.847		40′	890.41	68.774		40′	1410.9	171.15	
50′	392.28	13.413		50′	898.95	70.091		50′	1419.7	173.27	
8°	400.66	13.991		18°	907.49	71.421		28°	1428.6	175.41	
10′	409.03	14.582		10′	916.03	72.764		10′	1437.4	177.55	
20′	417.41	15.184	25° C.	20′	924.58	74.119	25° C.	20′	1446.3	179.72	25° C.
30′	425.79	15.799	T	30′	933.13	75.488	T	30′	1455.1	181.89	T
40′	434.17	16.426	.16	40′	941.69	76.869	.32	40′	1464.0	184.08	.49
50′	442.55	17.065	E	50′	950.25	78.264	E	50′	1472.9	186.29	E
9°	450.93	17.717	.007	19°	958.81	79.671	.028	29°	1481.8	188.51	.065
10′	459.32	18.381		10′	967.38	81.092		10′	1490.7	190.74	
20′	467.71	19.058		20′	975.96	82.525		20′	1499.6	192.99	
30′	476.10	19.746		30′	984.53	83.972		30′	1508.5	195.25	
40′	484.49	20.447		40′	993.12	85.431		40′	1517.4	197.53	
50′	492.88	21.161		50′	1001.7	86.904		50′	1526.3	199.82	
10°	501.28	21.887	30° C.	20°	1010.3	88.389	30° C.	30°	1535.3	202.12	30° C.
10′	509.68	22.624	T	10′	1018.9	89.888	T	10′	1544.2	204.44	T
20′	518.08	23.375	.19	20′	1027.5	91.399	.39	20′	1553.1	206.77	.59
30′	526.48	24.138	E	30′	1036.1	92.924	E	30′	1562.1	209.12	E
40′	534.89	24.913	.008	40′	1044.7	94.462	.034	40′	1571.0	211.48	.078
50′	543.29	25.700		50′	1053.3	96.013		50′	1580.0	213.86	

$T = R \tan \frac{1}{2}I$ $E = R \operatorname{exsec} \frac{1}{2}I$

TABLE V CONTD. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=40°
31°	1589.0	216.3	+
10′	1598.0	218.7	5° C.
20′	1606.9	221.1	T
30′	1615.9	223.5	.13
40′	1624.9	226.0	E
50′	1633.9	228.4	
32°	1643.0	230.9	.023
10′	1652.0	233.4	
20′	1661.0	235.9	
30′	1670.0	238.4	
40′	1679 1	241.0	
50′	1688.1	243.5	
33°	1697.2	246.1	10° C.
10′	1706.3	248.7	T
20′	1715.3	251.3	.26
30′	1724.4	253.9	E
40′	1733.5	256.5	.046
50′	1742.6	259.1	
34°	1751.7	261.8	
10′	1760.8	264.5	
20′	1770.0	267.2	
30′	1779.1	269.9	
40′	1788.2	272.6	
50′	1797.4	275.3	15° C.
35°	1806.6	278.1	T
10′	1815.7	280.8	.40
20′	1824.9	283.6	E
30′	1834.1	286.4	.070
40′	1843.3	289.2	
50′	1852.5	292.0	
36°	1861.7	294.9	
10′	1870.9	297.7	
20′	1880.1	300.6	
30′	1889.4	303.5	
40′	1898.6	306.4	20° C.
50′	1907.9	309.3	T
37°	1917 1	312.2	.53
10′	1926.4	315.2	E
20′	1935.7	318 1	.093
30′	1945.0	321.1	
40′	1954.3	324.1	
50′	1963 6	327.1	
38°	1972.9	330.2	
10′	1982.2	333.2	25° C.
20′	1991.5	336.3	T
30′	2000.9	339.3	.67
40′	2010.2	342.4	E
50′	2019.6	345.5	
39°	2029.0	348.6	117
10′	2038.4	351.8	
20′	2047.8	354.9	
30′	2057.2	358.1	
40′	2066.6	361.3	
50′	2076.0	364.5	
40°	2085.4	367.7	30° C.
10′	2094.9	371.0	T
20′	2104.3	374.2	.80
30′	2113.8	377.5	E
40′	2123.3	380.8	.141
50′	2132.7	384 1	

I	T	E	I=50°
41°	2142.2	387.4	+
10′	2151.7	390.7	5° C.
20′	2161.2	394 1	T
30′	2170.8	397.4	.17
40′	2180.3	400.8	E
50′	2189.9	404.2	
42°	2199.4	407.6	.037
10′	2209.0	411.1	
20′	2218.6	414.5	
30′	2228.1	418.0	
40′	2237.7	421.4	
50′	2247.3	425.0	
43°	2257.0	428.5	10° C.
10′	2266.6	432.0	T
20′	2276.2	435.6	.34
30′	2285.9	439.2	E
40′	2295.6	442.8	.075
50′	2305.2	446 4	
44°	2314 9	450.0	
10′	2324.6	453.6	
20′	2334.3	457.3	
30′	2344 1	461.0	
40	2353.8	464.6	
50′	2363.5	468.4	15° C.
45°	2373.3	472.1	T
10′	2383.1	475.8	.51
20′	2392.8	479.6	E
30′	2402.6	483 4	.116
40′	2412.4	487.2	
50′	2422.3	491.0	
46°	2432.1	494.8	
10′	2441.9	498.7	
20′	2451 8	502.5	
30′	2461.7	506.4	
40′	2471.5	510.3	20° C.
50′	2481.4	514.3	T
47°	2491.3	518.2	.68
10′	2501.2	522 2	E
20′	2511.2	526.1	151
30′	2521.1	530.1	
40′	2531.1	534.2	
50′	2541.0	538.2	
48°	2551.0	542.2	
10′	2561.0	546.3	
20′	2571.0	550.4	25° C.
30′	2581.0	554.5	T
40′	2591.0	558.6	.85
50′	2601.1	562.8	E
49°	2611.2	566.9	.189
10′	2621.2	571.1	
20′	2631.3	575.3	
30′	2641.4	579.5	
40′	2651.5	583.8	
50′	2661.6	588.0	
50°	2671.8	592.3	30° C.
10′	2681.9	596.6	T
20′	2692.1	600.9	1.02
30′	2702 3	605.3	E
40′	2712.5	609 6	.227
50′	2722.7	614.0	

I	T	E	I=60°
51°	2732.9	618.4	+
10′	2743.1	622.8	5° C.
20′	2753.4	627.2	T
30′	2763.7	631.7	.21
40′	2773.9	636.2	E
50′	2784.2	640.7	
52°	2794.5	645.2	.056
10′	2804.9	649.7	
20′	2815.2	654.3	
30′	2825 6	658.8	
40′	2835.9	663.4	
50′	2846.3	668.0	
53°	2856.7	672.7	10° C.
10′	2867.1	677.3	T
20′	2877.5	682.0	42
30′	2888.0	686.7	E
40′	2898.4	691.4	.112
50′	2908.9	696.1	
54°	2919.4	700.9	
10′	2929.9	705.7	
20′	2940.4	710.5	
30′	2951.0	715.3	
40′	2961.5	720.1	
50′	2972.1	725.0	15° C.
55°	2982.7	729.9	T
10′	2993.3	734.8	.63
20′	3003.9	739.7	E
30′	3014.5	744.6	.168
40′	3025.2	749.6	
50′	3035.8	754.6	
56°	3046.5	759 6	
10′	3057.2	764.6	
20′	3067 9	769.7	
30′	3078.7	774.7	20° C.
40′	3089.4	779.8	T
50′	3100.2	784.9	.84
57°	3110.9	790.1	E
10′	3121.7	795.2	.225
20′	3132.6	800.4	
30′	3143.4	805.6	
40′	3154.2	810.9	
50′	3165.1	816.1	
58°	3176.0	821.4	
10′	3186.9	826.7	
20′	3197.8	832.0	25° C.
30′	3208.8	837.3	T
40′	3219 7	842.7	1.05
50′	3230.7	848.1	E
59°	3241.7	853.5	.283
10′	3252.7	858.9	
20′	3263.7	864.3	
30′	3274.8	869.8	
40′	3285.8	875.3	
50	3296.9	880.8	
60°	3308.0	886.4	30° C.
10′	3319.1	892.0	T
20′	3330.3	897.5	1.27
30′	3341.4	903.2	E
40′	3352.6	908.8	
50′	3363.8	914.5	

$T = R \tan \frac{1}{2} I$ $E = R \operatorname{exsec} \frac{1}{2} I$

TABLE V CONTD. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=70°
61°	3375.0	920.2	+
10′	3386.3	925.9	5° C.
20′	3397.5	931.6	T
30′	3408.8	937.3	.25
40′	3420.1	943.1	E
50′	3431.4	948.9	
62°	3442.7	954.8	.080
10′	3454.1	960.6	
20′	3465.4	966.5	
30′	3476.8	972.4	
40′	3488.3	978.3	
50′	3499.7	984.3	
63°	3511.1	990.2	10° C.
10′	3522 6	996.2	T
20′	3534.1	1002.3	.51
30′	3545.6	1008.3	E
40′	3557.2	1014.4	.159
50′	3568.7	1020.5	
64°	3580.3	1026.6	
10′	3591.9	1032.8	
20′	3603.5	1039.0	
30′	3615.1	1045.2	
40′	3626.8	1051.4	
50′	3638.5	1057.7	15° C.
65°	3650.2	1063.9	T
10′	3661.9	1070.2	.76
20′	3673.7	1076.6	E
30′	3685.4	1082.9	.240
40′	3697.2	1089.3	
50′	3709.0	1095.7	
66°	3720.9	1102.2	
10′	3732.7	1108.6	
20′	3744.6	1115.1	
30′	3756.5	1121.7	
40′	3768.5	1128.2	20° C.
50′	3780.4	1134.8	T
67°	3792.4	1141.4	1.02
10′	3804.4	1148.0	E
20′	3816.4	1154.7	.321
30′	3828.4	1161.3	
40′	3840.5	1168.1	
50′	3852.6	1174.8	
68°	3864.7	1181.6	
10′	3876.8	1188.4	
20′	3889.0	1195.2	25° C.
30′	3901.2	1202.0	T
40′	3913 4	1208.9	1.28
50′	3925.6	1215.8	E
69°	3937.9	1222.7	.403
10′	3950.2	1229.7	
20′	3962.5	1236.7	
30′	3974.8	1243.7	
40′	3987.2	1250.8	
50′	3999.5	1257.9	
70°	4011.9	1265.0	30° C.
10′	4024.4	1272.1	T
20′	4036.8	1279.3	1.54
30′	4049.3	1286.5	E
40′	4061.8	1293.6	.485
50′	4074.4	1300.9	

I	T	E	I=80°
71°	4086.9	1308.2	+
10′	4099.5	1315.6	5° C.
20′	4112.1	1322.9	T
30′	4124.8	1330.3	.30
40′	4137.4	1337.7	E
50′	4150 1	1345.1	
72°	4162.8	1352.6	.110
10′	4175.6	1360.1	
20′	4188.5	1367.6	
30′	4201.2	1375.2	
40′	4214.0	1382.8	
50′	4226.8	1390.4	
73°	4239.7	1398.0	10° C.
10′	4252.6	1405.7	T
20′	4265.6	1413.5	.61
30′	4278.5	1421.2	E
40′	4291.5	1429.0	.220
50′	4304.6	1436.8	
74°	4317.6	1444.6	
10′	4330.7	1452.5	
20′	4343.8	1460.4	
30′	4356.9	1468.4	
40′	4370.1	1476.4	
50′	4383.3	1484.4	15° C.
75°	4396.5	1492.4	T
10′	4409.8	1500.5	.91
20′	4423.1	1508.6	E
30′	4436.4	1516.7	.332
40′	4449.7	1524.9	
50′	4463,1	1533.1	
76°	4476.5	1541.4	
10′	4489.9	1549.7	
20′	4503.4	1558.0	
30′	4516.9	1566.3	
40′	4530.4	1574.7	20° C.
50′	4544.0	1583.1	T
77°	4557.6	1591.6	1.22
10′	4571.2	1600.1	E
20′	4584.8	1608.6	.445
30′	4598.5	1617.1	
40′	4612.2	1625.7	
50′	4626.0	1634.4	
78°	4639.8	1643.0	
10′	4653.6	1651.7	
20′	4667.4	1660.5	25° C.
30′	4681.3	1669.2	T
40′	4695.2	1678.1	1.53
50′	4709.2	1686.9	E
79°	4723.2	1695.8	.558
10′	4737.2	1704.7	
20′	4751.2	1713.7	
30′	4765 3	1722.7	
40′	4779.4	1731.7	
50′	4793.6	1740.8	
80°	4807.7	1749.9	30° C.
10′	4822.0	1759.0	T
20′	4836.2	1768.2	1.84
30′	4850.5	1777.4	E
40′	4864.8	1786.7	.671
50′	4879.2	1796.0	

I	T	E	I=90°
81°	4893.6	1805.3	+
10′	4908.0	1814.7	5° C.
20′	4922.5	1824.1	T
30′	4937.0	1833.6	.36
40′	4951.5	1843.1	E
50′	4966.1	1852.6	
82°	4980.7	1862.2	.149
10′	4995.4	1871.8	
20′	5010.0	1881.5	
30′	5024.8	1891.2	
40′	5039.5	1900.9	
50′	5054.3	1910.7	
83°	5069.2	1920.5	10° C.
10′	5084.0	1930.4	T
20′	5099.0	1940.3	.72
30′	5113.9	1950.3	E
40′	5128.9	1960.2	.299
50′	5143.9	1970.3	
84°	5159.0	1980.4	
10′	5174.1	1990.5	
20′	5189.3	2000.6	
30′	5204.4	2010.8	
40′	5219,7	2021.1	
50′	5234.9	2031,4	15° C.
85°	5250.3	2041.7	T
10′	5265.6	2052.1	1.09
20′	5281.0	2062.5	E
30′	5296.4	2073.0	.450
40′	5311.9	2083.5	
50′	5327.4	2094.1	
86°	5343.0	2104.7	
10′	5358.6	2115.3	
20′	5374.2	2126.0	
30′	5389.9	2136.7	
40′	5405.6	2147.5	20° C.
50′	5421.4	2158.4	T
87°	5437 2	2169.2	1.45
10′	5453.1	2180.2	E
20′	5469.0	2191.1	.603
30′	5484.9	2202.2	
40′	5500.9	2213.2	
50′	5517.0	2224.3	
88°	5533.1	2235.5	
10′	5549.2	2246.7	
20′	5565.4	2258.0	25° C.
30′	5581.6	2269.3	T
40′	5597.8	2280.6	1.83
50′	5614.2	2292.0	E
89°	5630.5	2303.5	.756
10′	5646.9	2315.0	
20′	5663.4	2326.6	
30′	5679.9	2338.2	
40′	5696.4	2349.8	
50′	5713.0	2361.5	
90°	5729.7	2373.3	30° C.
10′	5746.3	2385.1	T
20′	5763.1	2397.0	2.20
30′	5779.9	2408.9	E
40′	5796.7	2420.9	.910
50′	5813.6	2432.9	

$T = R \tan \frac{1}{2} I$ $E = R \operatorname{exsec} \frac{1}{2} I$

TABLE V CONTD. TANGENTS AND EXTERNALS TO A 1° CURVE

I	T	E	I=100°	I	T	E	I=110°	I	T	E	I=120°
91°	5830.5	2444.9	+	101°	6950.6	3278.1	+	111°	8336.7	4386.1	+
10′	5847.5	2457.1	5° C.	10′	6971.3	3294.1	5° C.	10′	8362.7	4407.6	5° C.
20′	5864.6	2469.3	T	20′	6992.0	3310.1	T	20′	8388.9	4429.2	T
30′	5881.7	2481.5	.43	30′	7012.7	3326.1	.51	30′	8415.1	4450.9	.62
40′	5898.8	2493.8	E	40′	7033.6	3342.3	E	40′	8441.5	4472.7	E
50′	5916.0	2506.1		50′	7054.5	3358.5		50′	8468.0	4494.6	
92°	5933.2	2518.5	.200	102°	7075.5	3374.9	.268	112°	8494.6	4516.6	.360
10′	5950.5	2531.0		10′	7096.6	3391.2		10′	8521.3	4538.8	
20′	5967.9	2543.5		20′	7117.8	3407.7		20′	8548.1	4561.1	
30′	5985.3	2556.0		30′	7139.0	3424.3		30′	8575.0	4583.4	
40′	6002.7	2568.6		40′	7160.3	3440.9		40′	8602.1	4606.0	
50′	6020.2	2581.3		50′	7181.7	3457.6		50′	8629.3	4628.6	
93°	6037.8	2594.0	10° C.	103°	7203.2	3474.4	10° C.	113°	8656.6	4651.3	10° C.
10′	6055.4	2606.8	T	10′	7224.7	3491.3	T	10′	8684.0	4674.2	T
20′	6073.1	2619.7	.86	20′	7246.3	3508.2	.103	20′	8711.5	4697.2	1.25
30′	6090.8	2632.6	E	30′	7268.0	3525.2	E	30′	8739.2	4720.3	E
40′	6108.6	2645.5	.401	40′	7289.8	3542.4	.536	40′	8767.0	4743.6	.721
50′	6126.4	2658.5		50′	7311.7	3559.6		50′	8794.9	4766.9	
94°	6144.3	2671.6		104°	7333.6	3576.8		114°	8822.9	4790.4	
10′	6162.2	2684.7		10′	7355.6	3594.2		10′	8851.0	4814.1	
20′	6180.2	2697.9		20′	7377.8	3611.7		20′	8879.3	4837.8	
30′	6198.3	2711.2		30′	7399.9	3629.2		30′	8907.7	4861.7	
40′	6216.4	2724.5		40′	7422.2	3646.8		40′	8936.3	4885.7	
50′	6234.6	2737.9	15° C.	50′	7444.6	3664.5	15° C.	50′	8965.0	4909.9	15° C.
95°	6252.8	2751.3	T	105°	7467.0	3682.3	T	115°	8993.8	4934.1	T
10′	6271.1	2764.8	1.30	10′	7489.6	3700.2	1.56	10′	9022.7	4958.6	1.93
20′	6289.4	2778.3	E	20′	7512.2	3718.2	E	20′	9051.7	4983.1	E
30′	6307.9	2792.0	.604	30′	7534.9	3736.2	.806	30′	9080.9	5007.8	1.09
40′	6326.3	2805.6		40′	7557.7	3754.4		40′	9110.3	5032.6	
50′	6344.8	2819.4		50′	7580.5	3772.6		50′	9139.8	5057.6	
96°	6363.4	2833.2		106°	7603.5	3791.0		116°	9169.4	5082.7	
10′	6382.1	2847.0		10′	7626.6	3809.4		10′	9199.1	5107.9	
20′	6400.8	2861.0		20′	7649.7	3827.9		20′	9229.0	5133.3	
30′	6419.5	2875.0		30′	7672.9	3846.5		30′	9259.0	5158.8	
40′	6438.4	2889.0	20° C.	40′	7696.3	3865.2	20° C.	40′	9289.2	5184.5	20° C.
50′	6457.3	2903.1	T	50′	7719.7	3884.0	T	50′	9319.5	5210.3	T
97°	6476.2	2917.3	1.74	107°	7743.2	3902.9	2.08	117°	9349.9	5236.2	2.52
10′	6495.2	2931.6	E	10′	7766.8	3921.9	E	10′	9380.5	5262.3	E
20′	6514.3	2945.9	.809	20′	7790.5	3940.9	1.08	20′	9411.3	5288.6	1.46
30′	6533.4	2960.3		30′	7814.3	3960.1		30′	9442.2	5315.0	
40′	6552.6	2974.7		40′	7838.1	3979.4		40′	9473.2	5341.5	
50′	6571.9	2989.2		50′	7862.1	3998.7		50′	9504.4	5368.2	
98°	6591.2	3003.8		108°	7886.2	4018.2		118°	9535.7	5395.1	
10′	6610.6	3018.4		10′	7910.4	4037.8		10′	9567.2	5422.1	
20′	6630.1	3033.1	25° C.	20′	7934.6	4057.4	25° C.	20′	9598.9	5449.2	25° C.
30′	6649.6	3047.9	T	30′	7959.0	4077.2	T	30′	9630.7	5476.5	T
40′	6669.2	3062.8	2.18	40′	7983.5	4097.1	2.61	40′	9662.6	5504.0	3.16
50′	6688.8	3077.7	E	50′	8008.0	4117.0	E	50′	9694.7	5531.7	E
99°	6708.6	3092.7	1.02	109°	8032.7	4137.1	1.36	119°	9727.0	5559.4	1.83
10′	6728.4	3107.7		10′	8057.4	4157.3		10′	9759.4	5587.4	
20′	6748.2	3122.9		20′	8082.3	4177.5		20′	9792.0	5615.5	
30′	6768.1	3138.1		30′	8107.3	4197.9		30′	9824.8	5643.8	
40′	6788.1	3153.3		40′	8132.3	4218.4		40′	9857.7	5672.3	
50′	6808.2	3168.7		50′	8157.5	4239.0		50′	9890.8	5700.9	
100°	6828.3	3184.1	30° C.	110°	8182.8	4259.7	30° C.	120°	9924.0	5729.7	30° C.
10′	6848.5	3199.6	T	10′	8208.2	4280.5	T	10′	9957.5	5758.6	T
20′	6868.8	3215.1	2.62	20′	8233.7	4301.4	3.14	20′	9991.0	5787.7	3.81
30′	6889.2	3230.8	E	30′	8259.3	4322.4	E	30′	10025.0	5817.0	E
40′	6909.6	3246.5		40′	8285.0	4343.6		40′	10059.0	5846.5	
50′	6930.1	3262.3	1.22	50′	8310.8	4364.8	1.63	50′	10093.0	5876.1	2.20

$T = R \tan \frac{1}{2} I$ $E = R \operatorname{exsec} \frac{1}{2} I$

USEFUL RELATIONS

Lineal feet	×.00019	=	miles
Lineal yards	×.0006	=	miles
Square inches	×.007	=	square feet
Square feet	×.111	=	square yards
Square yards	×.0002067	=	acres
Acres	×4840	=	square yards
Cubic inches	×.00058	=	cubic feet
Cubic feet	×.03704	=	cubic yards
Links	×.22	=	yards
Links	×.66	=	feet
Feet	×1.5	=	links

360° = 21600′ = 1296000″

Radius = arc of 57.2957790°

Arc of 1° (radius = 1) = .017453292

Arc of 1′ (radius = 1) = .000290888

Arc of 1″ (radius = 1) = .000004848

Curvature of Earth's surface = about 0.7 feet in 1 mile

Curvature in feet = 0.667 (Dist. in miles)^3

Difference between arc and chord length, 0.05 feet in 11½ miles

Probable error of a single observation = $0.6754\sqrt{\frac{\Sigma v^2}{n-1}}$

Error in chaining of 0.01 feet in 100 feet:

Due to—

1. Length of tape error of 0.01 feet
2. Alignment. One end 1.4 feet out of line
3. Sag of tape at center of 0.61 feet.
4. Temperature difference of 15°
5. Difference of pull of 15 lbs.

SQUARE MEASURE

144 sq. inches = 1 sq. ft.
9 sq. ft. = 1 sq. yard
30¼ sq. yds. = 1 sq. rd.
40 sq. rds. = 1 rood.
4 roods = 1 acre
640 acres = 1 sq. mile.

SURVEYORS' MEASURE

7.92 inches = 1 link.
25 links = 1 rod.
4 rds. = 1 chain.
10 sq. chains or 160 sq. rods = 1 acre.
640 acres = 1 sq. mile.
36 sq. miles (6 miles sq.) = 1 township.

TABLE VI. INCHES TO DECIMALS OF A FOOT

In.	0	1	2	3	4	5	6	7	8	9	10	11	In.
0	Foot	.0833	.1667	.2500	.3333	.4167	.5000	.5833	.6667	.7500	.8333	.9167	0
1-32	.0026	.0859	.1693	.2526	.3359	.4193	.5026	.5859	.6693	.7526	.8359	.9193	1-32
1-16	.0052	.0885	.1719	.2552	.3385	.4219	.5052	.5885	.6719	.7552	.8385	.9219	1-16
3-32	.0078	.0911	.1745	.2578	.3411	.4245	.5078	.5911	.6745	.7578	.8411	.9245	3-32
1-8	.0104	.0938	.1771	.2604	.3438	.4271	.5104	.5938	.6771	.7604	.8438	.9271	1-8
5-32	.0130	.0964	.1797	.2630	.3464	.4297	.5130	.5964	.6797	.7630	.8464	.9297	5-32
3-16	.0156	.0990	.1823	.2656	.3490	.4323	.5156	.5990	.6823	.7656	.8490	.9323	3-16
7-32	.0182	.1016	.1849	.2682	.3516	.4349	.5182	.6016	.6849	.7682	.8516	.9349	7-32
1-4	.0208	.1042	.1875	.2708	.3542	.4375	.5208	.6042	.5875	.7708	.8542	.9375	1-4
9-32	.0234	.1068	.1901	.2734	.3568	.4401	.5234	.6068	.6901	.7734	.8568	.9401	9-32
5-16	.0260	.1094	.1927	.2760	.3594	.4427	.5260	.6094	.6927	.7760	.8594	.9427	5-16
11-32	.0286	.1120	.1953	.2786	.3620	.4453	.5286	.6120	.6953	.7786	.8620	.9453	11-32
3-8	.0313	.1146	.1979	.2813	.3646	.4479	.5313	.6146	.6979	.7813	.8646	.9479	3-8
13-32	.0339	.1172	.2005	.2839	.3672	.4505	.5339	.6172	.7005	.7839	.8672	.9505	13-32
7-16	.0365	.1198	.2031	.2865	.3698	.4531	.5365	.6198	.7031	.7865	.8698	.9531	7-16
15-32	.0391	.1224	.2057	.2891	.3724	.4557	.5391	.6224	.7057	.7891	.8724	.9557	15-32
1-2	.0417	.1250	.2083	.2917	.3750	.4583	.5417	.6250	.7083	.7917	.8750	.9583	1-2
17-32	.0443	.1276	.2109	.2943	.3776	.4609	.5443	.6276	.7109	.7943	.8776	.9609	17-32
9-16	.0469	.1302	.2135	.2969	.3802	.4635	.5469	.6302	.7135	.7969	.8802	.9635	9-16
19-32	.0495	.1328	.2161	.2995	.3828	.4661	.5495	.6328	.7161	.7995	.8828	.9661	19-32
5-8	.0521	.1354	.2188	.3021	.3854	.4688	.5521	.6354	.7188	.8021	.8854	.9688	5-8
21-32	.0547	.1380	.2214	.3047	.3880	.4714	.5547	.6380	.7214	.8047	.8880	.9714	21-32
11-16	.0573	.1406	.2240	.3073	.3906	.4740	.5573	.6406	.7240	.8073	.8906	.9740	11-16
23-32	.0599	.1432	.2266	.3099	.3932	.4766	.5599	.6432	.7266	.8099	.8932	.9766	23-32
3-4	.0625	.1458	.2292	.3125	.3958	.4792	.5625	.6458	.7292	.8125	.8958	.9792	3-4
25-32	.0651	.1484	.2318	.3151	.3984	.4818	.5651	.6484	.7318	.8151	.8984	.9818	25-32
13-16	.0677	.1510	.2344	.3177	.4010	.4844	.5677	.6510	.7344	.8177	.9010	.9844	13-16
27-32	.0703	.1536	.2370	.3203	.4036	.4870	.5703	.6536	.7370	.8203	.9036	.9870	27-32
7-8	.0729	.1563	.2396	.3229	.4063	.4896	.5729	.6563	.7396	.8229	.9063	.9896	7-8
29-32	.0755	.1589	.2422	.3255	.4089	.4922	.5755	.6589	.7422	.8255	.9089	.9922	29-32
15-16	.0781	.1615	.2448	.3281	.4115	.4948	.5781	.6615	.7448	.8281	.9115	.9948	15-16
31-32	.0807	.1641	.2474	.3307	.4141	.4974	.5807	.6641	.7474	.8307	.9141	.9974	31-32
	0	1	2	3	4	5	6	7	8	9	10	11	

TABLE VII. MINUTES IN DECIMALS OF A DEGREE

0′ 30″	.00833	10′ 30″	.17500	20′ 30″	.34167	30′ 30″	.50833	40′ 30″	.67500	50′ 30″	.84167
1 00	.01667	11 00	.18333	21 00	.35000	31 00	.51667	41 00	.68333	51 00	.85000
30	.02500	30	.19167	30	.35833	30	.52500	30	.69167	30	.85833
2 00	.03333	12 00	.20000	22 00	.36667	32 00	.53333	42 00	.70000	52 00	.86667
30	.04167	30	.20833	30	.37500	30	.54167	30	.70833	30	.87500
3 00	.05000	13 00	.21667	23 00	.38333	33 00	.55000	43 00	.71667	53 00	.88333
30	.05833	30	.22500	30	.39167	30	.55833	30	.72500	30	.89167
4 00	.06667	14 00	.23333	24 00	.40000	34 00	.56667	44 00	.73333	54 00	.90000
30	.07500	30	.24167	30	.40833	30	.57500	30	.74167	30	.90833
5 00	.08333	15 00	.25000	25 00	.41667	35 00	.58333	45 00	.75000	55 00	.91667
30	.09167	30	.25833	30	.42500	30	.59167	30	.75833	30	.92500
6 00	.10000	16 00	.26667	26 00	.43333	36 00	.60000	46 00	.76667	56 00	.93333
30	.10833	30	.27500	30	.44167	30	.60833	30	.77500	30	.94167
7 00	.11667	17 00	.28333	27 00	.45000	37 00	.61667	47 00	.78333	57 00	.95000
30	.12500	30	.29167	30	.45833	30	.62500	30	.79167	30	.95833
8 00	.13333	18 00	.30000	28 00	.46667	38 00	.63333	48 00	.80000	58 00	.96667
30	.14167	30	.30833	30	.47500	30	.64167	30	.80833	30	.97500
9 00	.15000	19 00	.31667	29 00	.48333	39 00	.65000	49 00	.81667	59 00	.98333
30	.15833	30	.32500	30	.49167	30	.65833	30	.82500	30	.99167
10 00	.16667	20 00	.33333	30 00	.500000	40 00	.66667	50 00	.83333	60 00	1.00000

TABLE VIII. MIDDLE ORDINATES OF RAILS

Length of Rail (feet)

C ° ′	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch	C °	R Feet	30 Inch	28 Inch	26 Inch	24 Inch	22 Inch	20 Inch
0–20	17189	.08	.07	.06	.05	.04	.03	8	716.8	1.88	1.64	1.42	1.20	1.01	.84
0–40	8594	.16	.14	.12	.10	.08	.07	9	637.3	2.12	1.84	1.60	1.35	1.14	.94
1–0	5730	.24	.20	.18	.15	.13	.10	10	573.7	2.36	2.05	1.78	1.50	1.27	1.04
1–20	4297	.31	.27	.23	.20	.17	.13	11	521.7	2.59	2.26	1.95	1.65	1.39	1.15
1–40	3438	.39	.34	.29	.25	.21	.17	12	478.3	3.83	2.47	2.15	1.81	1.54	1.26
2–0	2865	.47	.41	.35	.30	.25	.20	13	441.7	3.05	2.66	2.30	1.96	1.66	1.36
2–20	2456	.55	.48	.41	.35	.29	.23	14	410.3	3.30	2.87	2.48	2.10	1.78	1.46
2–40	2149	.63	.55	.47	.40	.33	.27	15	383.1	3.54	3.08	2.68	2.26	1.91	1.57
3–0	1910	.71	.62	.53	.45	.38	.31	16	359.3	3.76	3.28	2.83	2.40	2.04	1.67
3–20	1719	.78	.68	.59	.50	.42	.35	17	338.3	4.00	3.48	3.02	2.57	2.16	1.78
3–40	1563	.86	.75	.65	.55	.46	.38	18	319.6	4.21	3.67	3.18	2.70	2.28	1.87
4–0	1433	.94	.82	.71	.60	.50	.42	19	302.9	4.45	3.89	3.36	2.86	2.41	1.98
4–20	1323	1.02	.89	.77	.65	.55	.45	20	287.9	4.70	4.09	3.55	3.00	2.54	2.09
4–40	1228	1.10	.96	.83	.70	.59	.48	22	262.0	5.16	4.44	3.84	3.30	2.80	2.29
5	1146	1.18	1.03	.89	.75	.63	.52	24	240.5	5.64	4.92	4.20	3.59	3.04	2.50
6	955.3	1.41	1.23	1.06	.90	.76	.62	26	222.3	6.07	5.29	4.58	3.88	3.29	2.70
7	819.0	1.65	1.44	1.24	1.05	.89	.73								

TABLE IX. SHORT RADIUS CURVES

Radius Feet	Chord Feet	Central Angle	Deflection Angle	Deflection for 1 Foot
35	10	16-26	8-13	49.3
45	10	12-46	6-23	38.3
50	15	17-16	8-38	34.5
60	15	14-22	7-11	28.8
75	15	11-30	5-45	23.0
100	20	11-30	5-45	17.3
120	20	9-34	4-47	14.3
150	20	7-39	3-49	11.5
190	25	7-32	3-46	9.15
200	25	7-10	3-35	8.6
225	25	6-25	3-12	7.7
240	25	5-58	2-59	7.2
250	25	5-44	2-52	6.9
275	25	5-12	2-36	6.2
288	50	9-58	4-59	6.0
300	50	9-32	4-46	5.7
350	50	8-12	4-06	4.9
376	50	7-40	3-50	4.6
400	50	7-10	3-35	4.3
410	50	7-00	3-30	4.2

To find length of curve divide angle from P. C. to P. T. by central angle of chord, and multiply by length of chord.

TABLE X. RODS IN FEET, 10THS AND 100THS OF FEET

Rods	Feet	Rods	Feet	Rods	Feet	Rods	Feet	Rods	Feet
1	16.50	21	346.50	41	676.50	61	1006.50	81	1336.50
2	33.00	22	363.00	42	693.00	62	1023.00	82	1353.00
3	49.50	23	379.50	43	709.50	63	1039.50	83	1369.50
4	66.00	24	396.00	44	726.00	64	1056.00	84	1386.00
5	82.50	25	412.50	45	742.50	65	1072.50	85	1402.50
6	99.00	26	429.00	46	759.00	66	1089.00	86	1419.00
7	115.50	27	445.50	47	775.50	67	1105.50	87	1435.50
8	132.00	28	462.00	48	792.00	68	1122.00	88	1452.00
9	148.50	29	478.50	49	808.50	69	1138.50	89	1468.50
10	165.00	30	495.00	50	825.00	70	1155.00	90	1485.00
11	181.50	31	511.50	51	841.50	71	1171.50	91	1501.50
12	198.00	32	528.00	52	858.00	72	1188.00	92	1518.00
13	214.50	33	544.50	53	874.50	73	1204.50	93	1534.50
14	231.00	34	561.00	54	891.00	74	1221.00	94	1551.00
15	247.50	35	577.50	55	907.50	75	1237.50	95	1567.50
16	264.00	36	594.00	56	924.00	76	1254.00	96	1584.00
17	280.50	37	610.50	57	940.50	77	1270.50	97	1600.50
18	297.00	38	627.00	58	957.00	78	1287.00	98	1617.00
19	313.50	39	643.50	59	973.50	79	1303.50	99	1633.50
20	330.00	40	660.00	60	990.00	80	1320.00	100	1650.00

TABLE XI. LINKS IN FEET, 10THS AND 100THS OF FEET

Links	Feet	Links	Feet	Links	Feet	Links	Feet	Links	Feet	Links	Feet
1	0.66	18	11.88	35	23.10	52	34.32	69	45.54	86	56.76
2	1.32	19	12.54	36	23.76	53	34.98	70	46.20	87	57.42
3	1.98	20	13.20	37	24.42	54	35.64	71	46.86	88	58.08
4	2.64	21	13.86	38	25.08	55	36.30	72	47.52	89	58.74
5	3.30	22	14.52	39	25.74	56	36.96	73	48.18	90	59.40
6	3.96	23	15.18	40	26.40	57	37.62	74	48.84	91	60.06
7	4.62	24	15.84	41	27.06	58	38.28	75	49.50	92	60.72
8	5.28	25	16.50	42	27.72	59	38.94	76	50.16	93	61.38
9	5.94	26	17.16	43	28.38	60	39.60	77	50.82	94	62.04
10	6.60	27	17.82	44	29.04	61	40.26	78	51.48	95	62.70
11	7.26	28	18.48	45	29.70	62	40.92	79	52.14	96	63.36
12	7.92	29	19.14	46	30.36	63	41.58	80	52.80	97	64.02
13	8.58	30	19.80	47	31.02	64	42.24	81	53.46	98	64.68
14	9.24	31	20.46	48	31.68	65	42.90	82	54.12	99	65.34
15	9.90	32	21.12	49	32.34	66	43.56	83	54.78	100	66.00
16	10.56	33	21.78	50	33.00	67	44.22	84	55.44	101	66.66
17	11.22	34	22.44	51	33.66	68	44.88	85	56.10	102	67.32

LIETZ
SINCE 1882

FIELD BOOKS

Rain resistant fine quality ledger paper, bound in high visibility chrome yellow imitation leather. Printed in waterproof ink.

Left page: blue horizontal lines; red vertical lines.
Right page: 4 horizontal and 8 vertical blue lines; red vertical center line.

Stock No. 8152-00 Transit Field Book. Size 4½ x 7¼ inches.
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Stock No. 8152-30 Engineers Field Book. Size 4½ x 7¼ inches.

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Right page: 4 x 4 blue lines; red vertical center line.

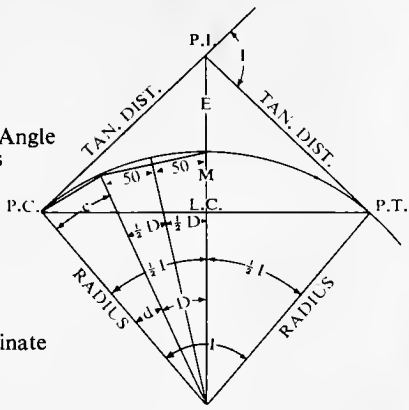
Stock No. 8152-60 Field Book. Size 4½ x 7¼ inches.

Both pages: 10 x 10 blue lines; inch lines slightly heavier.

Stock No. 8152-75 Cross Section Book. Size 6½ x 8½ inches.

CURVE FORMULAE

D = Degree of Curve
1° = 1-Degree of Curve
2° = 2-Degree of Curve
P.C. = Point of Curve
P.T. = Point of Tangent
P.I. = Point of Intersection
I = Intersection of Angle, Angle between Two Tangents
L = Length of Curve, from P.C. to P.T.
T = Tangent Distance
E = External Distance
R = Radius
L.C. = Length of Chord
M = Length of Middle Ordinate
c = Length of Sub-Chord
d = Angle of Sub-Chord



$$R = \frac{L.C.}{2 \sin \frac{1}{2} I} \quad T = R \tan \tfrac{1}{2} I = \frac{L.C.}{2 \cos \frac{1}{2} I}$$

$$\frac{L.C.}{2} = R \sin \frac{I}{2}, \; D\,1° = R = 5730, \; D\,2° = \frac{5730}{2}, \; D = \frac{5730}{R}$$

$$M = R (1 - \cos \tfrac{1}{2} I), \; = R - R \cos \frac{I}{2}$$

$$\frac{E + R}{R} = \sec \frac{I}{2}, \; \frac{R - M}{R} = \cos \frac{I}{2}$$

$$c = 2 R \sin \tfrac{1}{2} d, \; d = \frac{c}{2R}$$

$$L.C. = 2 R \sin \tfrac{1}{2} I, \; E = R (\sec \tfrac{1}{2} I - 1), \; = R \sec \frac{I}{2} - R$$

Minutes in Decimals of a Degree

1′	·0167	11′	·1833	21′	·3500	31′	·5167	41′	·6833	51′	·8500
2	·0333	12	·2000	22	·3667	32	·5333	42	·7000	52	·8667
3	·0500	13	·2167	23	·3833	33	·5500	43	·7167	53	·8833
4	·0667	14	·2333	24	·4000	34	·5667	44	·7333	54	·9000
5	·0833	15	·2500	25	·4167	35	·5833	45	·7500	55	·9167
6	·1000	16	·2667	26	·4333	36	·6000	46	·7667	56	·9333
7	·1167	17	·2833	27	·4500	37	·6167	47	·7833	57	·9500
8	·1333	18	·3000	28	·4667	38	·6333	48	·8000	58	·9667
9	·1500	19	·3167	29	·4833	39	·6500	49	·8167	59	·9833
10	·1667	20	·3333	30	·5000	40	·6667	50	·8333	60	1·0000

Inches in Decimals of a Foot

$\frac{1}{16}$	$\frac{3}{32}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$
·0052	·0078	·0104	·0156	·0208	·0260	·0313	·0417	·0521	·0625	·0729

1	2	3	4	5	6	7	8	9	10	11
·0833	·1667	·2500	·3333	·4167	·5000	·5833	·6667	·7500	·8333	·9167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